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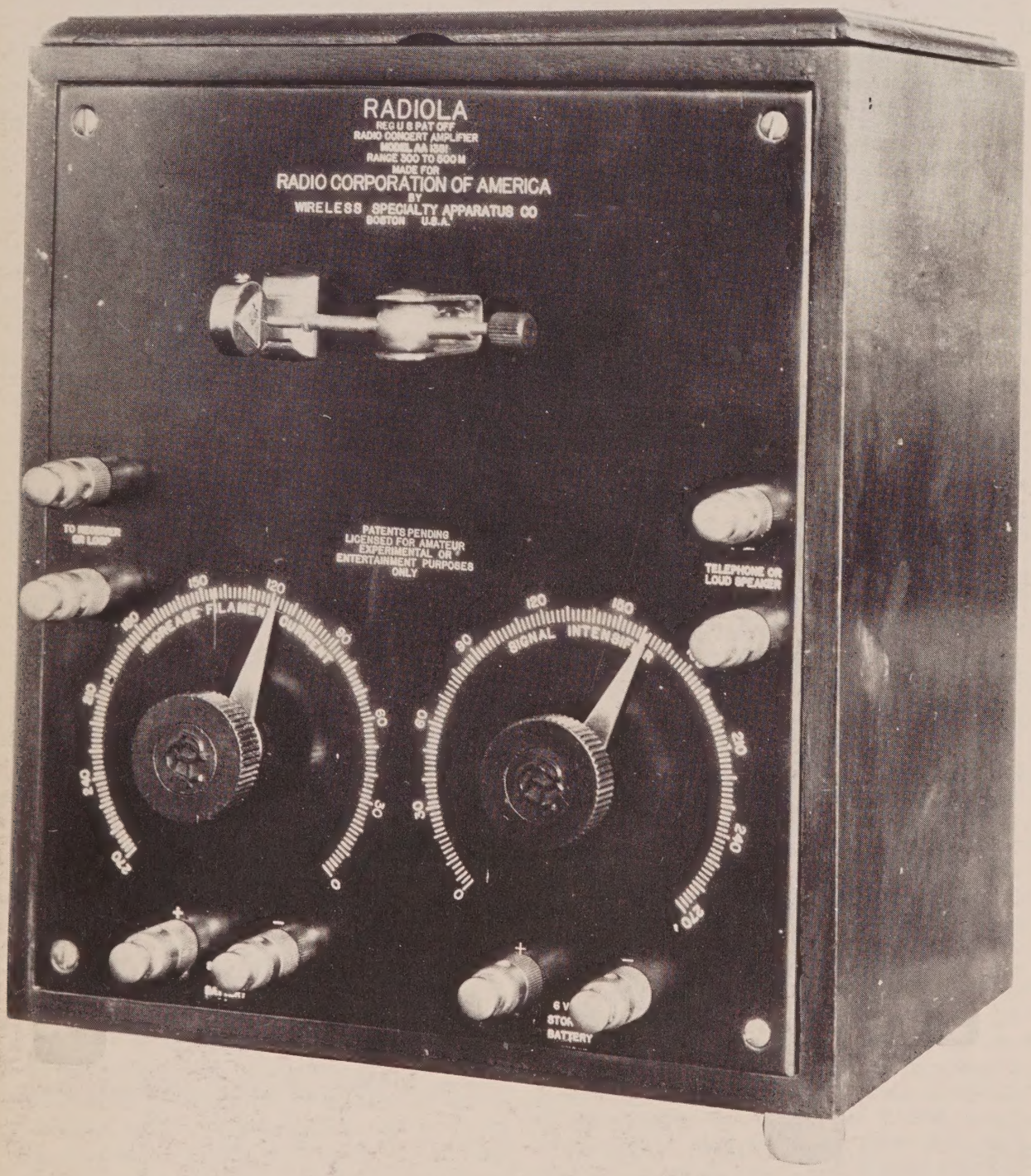

SPECIAL ANNIVERSARY ISSUE

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The "Old Timer's Bulletin": The AWA Journal

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THE COVER

The Radiola AA-1381, made by the Wireless Specialty Apparatus Company for RCA, ca. 1922. WSA was the smallest member of the RCA group, making far less equipment than GE or Westinghouse. The AA-1381 was a one-tube "radio concert amplifier" with 300-500 meter (600-1000 kHz) tuning range. It could be used with the AG-1380 antenna loop and an additional loudspeaker amplifier. From Vol. 17, No. 3, Dec. 1976.

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FROM THE EDITOR

1992 is the 40th anniversary year of AWA's founding by Bruce Kelley, George Batterson, and Lincoln Cundall. Beginning with mainly radio-amateur Kodak employees in the Rochester area, the Association has grown to almost 4000 members worldwide.

The OTB, started by Bruce Kelley early in 1960, soon became AWA's official member journal. Celebrating four decades of historian/collector effort, this special anthology issue presents selected reprints in three classes: regular OTB features, with all of Vol. 1, No. 1; OTB items on restoring equipment; and articles from the bulletin produced by Lauren Peckham for the AWA Tube Collectors Group. Appearing from 1976 to 1981, it reached a specialized circulation of only 200 or so.

Special thanks to the AWA Board, for squeezing this extra issue into an already full budget; to Bruce Kelley, for preserving early OTB printer's negatives for reuse; and to Lauren Peckham for original photo materials. - *Ludwell Sibley, KB2EVN*

ELECTRONIC EVENTS OF 1952

Television: ▪ The Dumont ("fourth") network was still in operation. ▪ The battle over electronic vs. disc color TV was in full fury; CBS, better known as color-wheel proponent, demonstrated an *all-electronic* receiver for its field-sequential system. ▪ The FCC lifted its 1948 freeze on new TV stations, imposed after earlier interference problems. George Sterling, W1AE, soon to be an AWA member, was on the Commission. ▪ The first commercial (non-experimental) UHF station signed on, in Portland, Oregon. ▪ New TV sets had 45-MHz IF stages to avoid severe interference to 21-MHz IFs from picking up amateur signals in the new 15-meter band. ▪ Wartime materials shortages meant that some sets were made with field-coil speakers; Al, Ni, and Co for Alnico magnets were hard to get. ▪ TV networks reached 114 stations in 71 cities.

Communications: ▪ In Korea, troops were using the radios of ten years before: BC-611 handie-talkies, BC-1000 walkie-talkies, SCR-399 medium-haul HF stations, and AN/TRC-1 radio-relay sets. However, replacements (AN/PRC-6, -PRC-10, -GRC-26, and -TRC-24 respectively) were soon to come. ▪ AT&T opened HF radiotelephone service to Iraq. ▪ On April 27, mud slides in a canyon 24 miles west of Salt Lake City cut the K-carrier systems in AT&T's central transcontinental cable, interrupting the national broadcast networks until rerouted. ▪ President Truman's official train had a car designed by the Signal Corps, fitted with high-power transmitters and four Hammarlund SP-600 receivers, for communication even in motion.

Radio: ▪ Tests by the BBC of VHF FM vs. VHF AM found that FM gave superior discrimination against ignition noise. ▪ The "Codetyper" automatic key used 40 tubes to generate Morse from a keyboard.

Development: ▪ Bell Labs held a symposium for patent licensees on designing and making the new transfer resistor or "transistor." ▪ Raytheon's CK716 point-contact transistor listed at $18 each. ▪ RCA introduced the 6146 tube, soon used widely in mobile/amateur transmitters up to 90 watts' input.

JANUARY 1960

The OLD TIMER'S BULLETIN

PRINTED FOR THE OLD TIME RADIO AMATEUR AND HISTORIAN

VOL. 1 W2ICE - EDITOR NO. 1

Well, fellows, there appears to be enough interest to type this sheet - so here goes. First of all, we're going to find out what you're interested in. Off hand, it appears the majority of you are old timers with a casual interest in collecting and preserving old pieces of wireless gear. Some of you specialize, such as W8JDV with Grebe equipment or W3WRE who concentrates on keys - whereas others have no interest in collecting but just want to keep in contact with the past.

In the future we'll endeavor to classify various interests by call letters. At present I'm taking the liberty of using only portions of the info received in each letter from you - saving the rest for later bulletins. Needless to say, dozens of letters were received, making it almost impossible to answer them all - tnx a lot. 73, W2ICE

IN GENERAL

The Radio Club of America celebrated its 50th anniversary, Dec. 4, 1959, having been founded in 1909 - so reports its president W2PXR.

How many of you read the passing of Jack Binns on Dec. 9 (75 yrs.)? All old timers - amateur and commercial alike - have heard of Jack and the White Star liner "Republic." Jack was the wireless operator who stayed at his post and sent out "CQD," the 1909 version of present "SOS." The result - 1600 persons were saved and the value of wireless reached an all-time high. In later years Jack became radio editor for the New York Tribune. In 1924 he joined the Hazeltine Corp. and eventually became president.

If in the Boston area, stop in and see Fred Penard at Norwood, Mass. Fred has a unique collection of electrical oddities other than radios, such as early telephones, medical machines, early bulbs, etc.

Remember the "Benwood Gap" - the product of two fellows by the names of Benson and Wood? Well, look up in your callbook and you'll fine Les Benson listed under the call W0ZB. The last time we worked him he was on 14 mc. phone!

At a recent IRE meet, W2QY and W2ICE found themselves on the same program with Dr. Alfred Goldsmith, Haraden Pratt, William White and Raymond Heising. Who sez the amateur historian doesn't travel with the pros - hi! They were told, by the way, that E. F. W. Alexanderson of alternator fame is still alive, having retired from General Electric. He is in his 80s, still active but somewhat deaf.

ABOUT OUR HOBBY

The amateur (non-professional) historian is in a minority as compared to other similar hobbyists such as antique car enthusiasts, coin and stamp collector or even the fair sex with their antique furniture. There are about 15 or 20 real "dyed-in-the-wool" historians in the U. S. A., plus an additional 100 who, shall we say, show an average interest in the subject. In addition, of course, there are thousands of old timers (amateur and commercial) who are devoted to the past - who love to reminisce, read about the old days and collect a few pieces of old gear. Amateur historians overseas are very rare; the AWA has made a few contacts with old-timers in Europe which has proven quite interesting - particularly fellows in England. We hope to give you more dope on this later.

ANNOUNCEMENT

The W2ZI historical collection and museum is now open for inspection. Since moving into a new home, his collection of early wireless apparatus, vacuum tubes (some dating back to 1907), books, magazines, photographs and a unique collection of old and odd Morse and wireless keys have been on display at 19 Blackwood Drive, Trenton, N. J.

It is all set up in a special room built for it and visitors are always welcome. Blackwood Drive is in the west end known as the Wilburtha section, and anyone passing through should call Ed Raser for an appointment. Call TU2-2000 during working hours and TU2-6645 after 5 PM.

TRAVELING WITH AN OLD TIMER

By Ed Raser, W2ZI

While on a recent vacation, I visited Harold Castner, W1IIE, who has written the "NBD" story, a book of some 5" thick telling of a famous naval coast station of the WW I period. I saw this book and later made a trip up to Otter Cliffs, Maine, to visit the site where the old station stood. NBD is famous for the tremendous amount of traffic handled during its lifetime. No other coast station could compete with it. Sometimes the daily count ran well over 1000 msgs. This was unprecedented, especially when one considers it was done with a 25-kW spark set. But the site overlooking the sea from the 80-foot high cliffs tells the story.

The men who did the work were crack telegraphers, and one of them happened to be the chief of the station - none other than Charles Ellsworth,

W1TU, of whom we will speak of another time. The book, now in the hands of Castner, will be used as a part of the history of naval radio, and is about to be written soon by official sources. The station commander received a citation from President Wilson for the outstanding work done during the wartime existence, as well as the excellent communications rendered the President on his trip to Europe in 1919.

Charlie, W1TU, the chief operator, also has a personal citation from the President, which he well deserved. No wireless men ever worked so faithfully at their job. They had to be supermen to take that much traffic in one day!

I can personally verify this as I was "out there" working old NBD myself!

"Ed" will give us more articles in the future. If anyone is qualified, I'm sure he is - although specializing somewhat in keys, W2ZI is just about the versatile all-around historian and collector in the country - No. 1 hi!

A trial "run-off" of our "Bulletin" indicates that the print isn't too clear on some copies - guess we'll have to look into the matter - something with regular print and photos would be much better - time will tell.

THE HENRY FORD MUSEUM, DEARBORN, MICH.

By "Tate," W8FX

Started 30 years ago, along with Greenfield Village, the Dearborn Museum was called the Edison Institute while Mr. Ford lived. It is now separate from Greenfield Village, although the replica of Edison's Menlo Park Laboratory is in Greenfield Village.

After you enter the museum, which costs $2 and is well worth it, you have a choice of many things to do. You cannot do justice to all the exhibits, or to yourself, in just one day's visit. There are two cafeterias, so you will not have to leave the museum for lunch. An attendant will give you a booklet showing where various exhibits are located, and if you prefer, leave you on your own. Radiomen will, of course, see that section first, and in any time left, see whatever else they fancy, most likely their second hobby.

The electrical/wireless exhibit starts with thousands of illuminating lamps, all appropriately marked, as are all the exhibits. As you walk past the filled show cases, you come to old telephone and telegraph sets, which then leads you to the wireless exhibit.

Depending on your taste as a collector and/or raconteur, the most popular item is near the end of the wireless exhibit: but don't fail to stand alongside old NAA's rotary spark gap wheel, and have your picture taken. When you do, you will "feel" the ghosts of the famous old-time wireless men hovering all around you. Gives you an eerie but uplifting feeling!

But before you get to the NAA spark wheel, there is the Marconi spark set that sent the first "S" across the Atlantic in complete and original form. A "pix" of this is also a must. Then, in good order, are the Mecograph, Albright and Martin "bugs," a "Yetman," Bunnell sideswiper, a "cootie-key," and straight keys made before you were born. There are coherers, Gernsback crystal detectors, loose couplers, spark coils and headsets, as well as Arnold and Navy loose couplers.

Name it and it is there: several magnetic detectors, complete Murdock transmitters, De Forest, Amrad and Fessenden gear, Colin B. Kennedy, Turney, Telefunken, Grebe, Mesco, Paragon, CRL (later Zenith), Brandes, Stromberg-Carlson, Mignon and William B. Duck - all are waiting to say a belated "hi!" to the newer radio man who was not fortunate to have lived with the "greats" of the past.

If you, as a radioman, haven't visited a great museum, like the Henry Ford Museum, you really haven't "lived." The writer has visited the Ford, the Michigan Historical Museum at Lansing, Mich., the AWA Museum at Holcomb, N. Y., Ed Raser's W2ZI Museum in Trenton, N. J., and the ARRL Headquarters Museum in West Hartford. All of these are worth visiting, but the "spirits" of the departed truly "greats" of wireless still hover around the wireless exhibit at the Henry Ford Museum at Dearborn.

"Tate" has done a terrific job of covering this famous museum for us. He promises to give us another writeup in the future on the historical museum in Lansing, which he is very closely associated with. W8FX, by the way, is a real "OT," a historian, a collector, the SCM for Michigan and a "dyed-in-the-wool" CW man!

Other museums and historical exhibits which we will report on in the future:

Perham (de Forest) Museum, California
The Edison Museum, West Orange, NJ
Western Union Museum, New York City
Franklin Institute, Philadelphia
Smithsonian Institution, Washington, DC
Canadian Bell Museum, Montreal, Quebec
British Museum, South Kensington, England
W2ZI Museum, Trenton, NJ
Antique Wireless Assn. Museum, Holcomb, NY

There are numerous club and private museums which we may not have heard of - drop us a line and tell us about them.

WA2HPO is photographing in chronological order the development of the vacuum tube. It will consist of a series of 8 X 10 glossy enlargements accompanied by a descriptive sheet. Each enlargement will picture 4 to 8 tubes in minute detail.

This portfolio should prove of great value to the average tube collector and historian since it will

cover most of the early American as well as many foreign tubes.

WITH THE HISTORIANS

W7OE holds the "fort" for the historians on the West Coast. Howard's most recent article was in the November issue of *Electronics World* (*Radio News* to you OTs) - and it should be read by all - particularly collectors. Another one to buy is this month's *Electronics Illustrated* where he has a story covering the old radio service of the U. S. Dept. of Commerce. W7OE was a former radio inspector under this department.

W0KKP tells us about a memorial station that may be erected in the memory of Boyd Phelps, W0BP. "Beep" was truly a pioneer amateur - an outstanding VHF experimenter in the early days as 2EB and later a pioneer with RTTY. His untimely death is a great loss to amateur radio.

VE3CO promises to give us, sometime in the future, the true story of an SOS that he sent out back in 1924.

Ex-3DW is a real OT with a rich historical background. "Ed" now works for the Nems-Clarke Company which, years ago, took over the old National Electric Supply Co. - remember?

W1NF is another genuine historian and has written some very fine articles for the *Yasme News* (a DX paper). Art is interested in hearing from old-timers who have had unusual experiences either as an amateur or commercial "op."

W9GFS hit the "jackpot" recently when he found that an old receiver he had was a rare CN-113A made by the National Electric Supply Co., circa 1917. Ed, ex-3DW, gave him the dope.

W9EWH reports that business has reduced his amateur activities, however, we hope that Frank can find time in the future to tell us about his VY FB collection - one of the oldest in the country.

W2QY recently restored an American Marconi 106, which proved to be quite an interesting experience. "Link" promises to give us some dope on some of his restoration projects in future issues. He is the man to contact, by the way, if you have trouble getting a coherer working.

W2LK is a pioneer in police radio as well as early BC. He and W2ZI have a lot in common.

W6ELW reports having made a one-hour tape recording of John Reinartz, K6BJ, ex-1QP, etc., relating his early experiences, the development of the Reinartz receiver, the first transatlantic QSO, etc.; several FB photos were also taken. (This tape recording will become part of the AWA's ever-increasing historical tape library.)

W2AAA is doing an excellent job of keeping the "old daze" alive by writing a series of articles for *CQ* magazine. (Ed. note: the articles are a must for the collector's file.)

W3WRE is working on a show covering the development of telegraphy from Morse to teletype - more about this later. It is a "she," by the way, her name is Louise or "Lou"!

W4AA just completed his 40th year as 4AA - congrats, Wayne! He is in the BC business and we hope to hear more from him.

W2IA recently bought an SW-3, a pair of "Baldies" and a "magy" speaker from the widow of a ham who had used this equipment until a year ago. Who sez the "ol' gear" can't compete?

W6GVY and yours truly have noticed the sudden interest in collecting. Paul notes there were six collectors advertising is December *QST*.

W8OP is the real old timer in the group, having started in on Morse in 1893! Ed, incidentally, is 87 years old and can be heard on 3812 kc regularly.

Ed. note: It appears we have three old time amateurs who are currently writing FB articles for magazines - W1NF, W2AAA and W7OE. Guess these three are going to see to it that we don't forget the past - hi!

Definition of noncommercial: several have asked what we mean when we say the *Bulletin* is only for the amateur. The thought is to print it for those who have old-time radio as their hobby - not business. Swapping old gear and writing an occasional historical article, I'm sure, falls into the hobby category.

WITH THE COLLECTORS

Swap - 60 issues of *QST* from 1916 through 1936. Need March to August 1916 and April & September 1917 and April 1922. W2IA, RD 1, Johnstown Rd., Oxford, New Jersey.

Wanted - Grebe equipment of any kind - also Grebe parts and literature. W8JDV, 500 Church St., Mason, Ohio.

Swap - De Forest DL and DV series (tubes) for UV-217 rectifier (similar to 50-watter). W2ICE.

Wanted - Atwater Kent horn speakers model F, G, H or L. C. A. Cummings, 5911 Rhode Island Ave., Cincinnati.

Want - Photographs (preferably 8 x 10 enlargements) of early broadcast receivers such as crystal sets, 3-circuit tuners, Neutrodynes, etc. W2AAA, 223 W. Holley Ave., Pitman, New Jersey.

Want - Vol. 1 & 2 of "Everyday Mechanics" (1915-16). W9AX, RR 2, Shelbyville, Indiana.

Swap - Or cash for IP-76, Marconi multiple tuner or magnetic detector. Have many fine pieces of old commercial gear. W1AAT, 422 Lafayette St., Salem, MA.

Wanted - $50 cash for May *QST*, 1916, in good condition, or will swap January, 1916, for same. W4AA, Wayne Nelson, Concord, North Carolina.

Swap - SCR-65 airplane spark transmitter for what have you. W6GVY, 2429 San Carlos Ave., San Carlos, Calif.

Sell - Copies of the "pink slip" from *QST*, Nov. 1919. W1AAT, 422 Lafayette St., Salem, Mass.

Swap or buy - *Radio News*, Sept. & Oct. 1921. Also need *C. D. Capacitor* (monthly publication) for Vol. 1-4 (Oct., Dec. 1939) and Vol. 3-2 (June & Dec. 1939). Joe Simpson, 85-39 152nd St., Jamaica 32, L.I., New York.

A BRIEF HISTORY OF EARLY DETECTORS

George Applegate, W2IA

THE COHERER

Vol. 2, No. 2, April, 1961

Many experimenters and scientists were involved in the genesis of the coherer. Contributions of some of the principals are briefly described here.

In Hertz' famous experiments of 1886-87, he employed a very simple device for detecting high-frequency radio impulses. A loop of wire with the ends open and spaced fairly close together acted as a spark gap. Minute sparks at the gap indicated a signal.

Twenty years before this, however, in 1866, Varley of England had taken what was probably the first step in a long and gradual evolution of another type of detector which would prove to be an indispensable device in the early period of wireless telegraphy.

In connection with some work on lightning protection for telegraph lines, Varley employed a small mass of dust between two electrodes as a shunting device to protect an indicating instrument against burning out. He conducted experiments with a number of substances ranging from pulverized carbon to ordinary house dust and observed "a decreasing resistance to an increasing electrical tension." By 1870, over a thousand of his "lightning bridges" were in successful operation in England. But, of course, the need for a radio detector was still to evolve.

Professor Calzecchi-Onesti, an Italian scientist, in 1886 developed a device similar in principle, consisting of copper filings between brass plates, and later other models using metal filings in glass tubes. He demonstrated that the resistance of the filings decreased over a very large range when an inductive surge passed through them. In addition, he found that the resistance remained at a low value if the filings were not mechanically disturbed. In the case of the glass-tube model, high resistance was restored to the filings by rotating the tube with a small crank attached to the end of the tube. Whether Hertz knew about this device is unknown. But it was soon to be employed in its destined task.

In 1891, about five years after Calzecchi-Onesti, Professor Edouard Branly of Paris described a similar instrument, which Sir Oliver Lodge called a "coherer," although Branly appears to have preferred the name "radioconductor." (De Forest named *his* device a "responder.") Branly's coherer consisted of a glass or ebonite tube filled with metal filings, with which contact was made by adjustable copper plugs at each end. A significant feature was a means of "de-cohering" the filings. This was accomplished by tapping the tube with a mechanical arrangement driven by clockwork or "by a trembling electrical mechanism" - a buzzer. Branly's vital discovery was that a spark discharge from a Leyden jar external to his coherer circuit would cause his filings to "cohere" and conduct.

Professor Popov of Russia in 1895 announced a further development. Using an "elevated wire" and ground, he developed an arrangement for recording lightning discharges which employed a metal-filings coherer and decohering tapper controlled by the received impulses themselves. The lightning impulses cohered the filings. Their lowered resistance permitted the operation of a relay from a local battery of cells. The relay energized a self-interrupting bell and clockwork-driven recorder. The clapper of the bell tapped the coherer and caused the filings to decohere and restore the high resistance. This released the relay, opening the circuit to the bell - and the equipment was ready for the next impulse.

Popov stated that his device was "applicable to the transmission of signals to a distance by means of rapid electrical vibrations." This - and actual demonstrations - comprise the basis on which the U. S. S. R. claims the invention of wireless. (Popov had no transmitter. He "demonstrated" only by receiving lightning pulses.) This description of the operation of Popov's equipment would also describe a good percentage of coherer-type receivers employed over the next several years by the early wireless-telegraph companies.

Before the turn of the century, the coherer had become an experimenter's plaything in a great many laboratories in Europe and England, usually taking the form of a glass tube equipped with metal plugs and metallic filings - perhaps iron, nickel or silver or combinations of these. But because of its value in "wireless," it went through a period of rapid development and was brought to a stage of considerable sensitivity and reliability by the Marconi interests.

MAGNETIC AND ELECTROLYTIC DETECTORS

Vol. 2, No. 4, Autumn, 1961

The coherer, in several variations of design, was essentially the standard detector during the initial seven or eight years of practical wireless. In 1895, however, Professor Rutherford of England had invented a "magnetic detector," whose final form helped bring the reign of the coherer to an end.

Rutherford's design was based on the research of Lord Rayleigh and others in the field of oscillatory currents. It had been found that the passage of a

high-frequency discharge through a coil wound around a small iron core resulted in demagnetizing the core. Rutherford's device consisted of a small solenoid of insulated copper wire, to whose terminals two antenna rods were connected. A very small core of fine iron wires was inserted inside the solenoid. A free-swinging magnetic needle, similar to a compass needle, equipped with a small mirror at one end, was located at one end of the iron core. This device was known as a magnetometer. When a wavetrain traversed the antenna winding, the residual magnetism of the core was altered and the needle was deflected; the attached mirror serving as a means of enabling an observer to discern very slight movements. This detector was sensitive enough to respond to sparks of a Hertz oscillator at a distance of half a mile. In this original model, it was necessary to remove the core from the solenoid and remagnetize it prior to each test. Professor Rutherford was credited by Professor Wilson as having produced an improved model using a moving wire band in 1900 or 1901.

Wilson, in 1897, improved upon Rutherford's original model by providing the magnetic needle with contacts which served to energize an additional winding employed to remagnetize the core after the reception of each wavetrain. During 1902, Wilson again revised the design so that the core was recharged repeatedly to an "alternately reversed magnetism by a periodic electric current." He also eliminated the needle and mirror, adding a new winding to which he connected a Bell telephone receiver.

Following the work of Rutherford and Wilson, Marconi produced two models of a magnetic detector in 1902, each of which employed two coils wound around an iron core. One coil was acted upon by the incoming signal and the other was connected to a telephone receiver. The first model employed a clockwork arrangement to rotate a horseshoe magnet slowly for the purpose of restoring magnetism to the core. Another design employed a magnet (or magnets) clamped in a fixed position, with the core so arranged that it travelled in the field of the magnets. An endless loop of iron wire, running on two clockwork-powered spools, served as the core. The wire travelled slowly through a small glass tube on which the two windings (antenna and telephone receiver) were located. This latter arrangement is the familiar Marconi magnetic detector. It was quite reliable and saw much service in Marconi stations, where it continued to be used as a "stand-by" detector long after more sensitive devices became available.

In 1898, A. Neugschwender and E. Aschkinass of Germany, and later Lee de Forest in the United States, developed detectors employing very narrow slits cut across strips of sheet-metal or tinfoil. Various forms of "electrolyte" were applied to the gaps in the conductors so as to form a bridge between the two pieces of metal which would act as a detector. A great many substances were tried out, "including Woodbury's Facial Cream," as de Forest says in his autobiography, published in 1950. His name for some of his mixtures was "goo." He called his detector a "responder." These detectors were "self-restoring" and apparently fairly sensitive but not very reliable and had the disadvantage that frequent replacement of the "goo" was required.

In 1903, Reginald Fessenden of the United States, Commander Ferrié of France, and W. Schloemilch of Germany independently developed electrolytic detectors of a new type. Typical of these was Fessenden's, which he called a "liquid barretter." It consisted of a small cup filled with a weak solution of nitric acid, in which the end of a piece of very fine platinum wire (Wollaston wire) was immersed. The incoming signals were applied across the terminals of the detector. A battery, in series with a resistance and a telephone receiver, was bridged across the detector, the battery potential causing electrolysis of the acid. This was accompanied by the formation of small gas bubbles around the tip of the platinum wire. These bubbles rapidly dissipated and were continually replaced with fresh ones. Much debate was generated in scientific circles as to the principle of operation of this device. Thermoelectric effects were championed by some, others claimed it was a rectifier, still others stated that the detector functioned in a manner similar to a mechanical interrupter, the gas bubbles acting as insulators. The electrolytic detector was quite successful and was in very wide use for several years. The advent of the crystal detectors, however, pushed the Electrolytic back into history.

CRYSTAL DETECTORS

Vol. 4, No. 3, Autumn 1963

In 1874, Ferdinand Braun, of Germany, made a report revealing unilateral conductivity effects he had discovered in devices employing small contact areas between metals and various oxides and sulfides. In 1901, Braun experimented further with a view to adapting these discoveries to the detection of wireless waves. Among other substances, he used galena and iron pyrites. Braun suggested to the Telefunken Company that work be undertaken on a crystal detector employing a substance called psilomelane, a complex mineral containing manganese oxide. This detector was brought to about the same degree of sensitivity as the currently popular electrolytic detectors.

In 1906, H. H. C. Dunwoody, a retired U. S. Army general, invented the carborundum detector. In his first models, Dunwoody made connections to the opposite ends of the crystal by wrapping wires around it. In other models, the crystal was

A BRIEF HISTORY OF THE FEDERAL TELEPHONE & TELEGRAPH CO.

Walt Weber, K2EE, ex-8TM

Vol. 5, No. 1, Spring 1964

The Federal Telephone and Telegraph Co. started in business before the first war manufacturing telephones and associated equipment. I worked for the company at this time installing telephones, but not in later years.

The telephone business became quite competitive with the Bell System, which also had a telephone exchange in Buffalo, so shortly after the war Federal turned to making radio equipment: transformers, earphones, speakers, buzzers and the familiar Federal hand mike.

Their receivers were the best of the time - all hand-made with the best materials and construction methods. This, with other factors, proved to be their ultimate downfall. Mass production by such companies as Crosley and Atwater Kent undercut Federal prices and then a lawsuit with the Acme Apparatus Co. of Cambridge, Mass. (who manufactured the power units of their later models) put the company in receivership in 1929.

The plant, located at 1708 Elmwood Ave., Buffalo, New York, employed about 200 men. Here they erected one of the first broadcast stations in the country - WGR. Typical of the era, it was breadboard-built. The station was later moved to the Statler Hotel and remains to this day.

Most historians and collectors, however, think of Federal for the very fine and distinctive receivers they made. The ultimate in battery sets was the Model 61, using five 201As and a 200. The panel had 16 knobs, including a rheostat for each tube!

The last models were the E-40 Arthoric series - a tuned RF job with 112-A output. This deluxe model also had a loop antenna.

Most of the chasses manufactured in the Elmwood plant were placed in cabinets at the Thomas Power Building on Niagara Street where Thomas motor cars were made between 1925 and 1926. Julian Layer was the manager of this plant.

The chief engineer of Federal was Lawrence Horle. The first assistant was Benedict French, 8BVK, who worked in the laboratory. Other hams at the plant were Art Benzie, then 8FE, now W4FE; Elmer Odien, 8BHQ; and George Sears, who is now with a broadcast station in California.

Benzie tested the E-40 receivers with Howard Seyse, ex-8AG, now W2KZ. They used a unique method of CW radio transmission. While testing they would touch the oscillator condenser, which threw the set out of oscillation. By sending backwards, they could communication with each other!

During this period, Seyse and Earnest Roy, ex-8RV, now W2AX, obtained special experimental calls 8XAJ and 8XAK and performed some unusual work including five-meter mobile operation which may have been the first in the country.

The rugged and distinctive style of the Federal receiver can be instantly recognized by the radio historian, a tribute to the old "gang" who worked for Federal 40 years ago.

(Continued from p. 8)

inserted between two parallel metal plates. Dunwoody found that the carborundum detector functioned with or without a local battery, but was somewhat more sensitive with the battery.

Later in the same year, H. Brandes of Germany, and, in 1907, Professor G. W. Pierce of the United States, published results of investigations into the behavior of crystal detectors of various types. It was found that the carborundum detector had an essentially flat voltage-current curve up to a point where a few volts were applied to the crystal. Beyond that point (it varied with different crystals), current abruptly increased with applied voltage. With a potentiometer-controlled battery connected in the detector circuit, adjusted to "bias" the crystal to this critical operating point, it was observed that the received signals were effectively rectified. Since carborundum is close to diamond in hardness and the crystal was literally jammed between its mounting plates under considerable pressure, the carborundum detector was an extremely rugged and dependable device. Powerful transmitters nearby, heavy static, and vibration had little effect on its operation. Its sensitivity was far superior to that of the magnetic detector, but considerably below that of the "catwhisker" and the light-pressure two-crystal types then being developed. Due to its reliability, however, it became widely used on ships and in land stations.

In 1906, Dr. L. W. Austin, of the U. S. Bureau of Standards, developed a tellurium-aluminum detector which functioned without a local battery. In the period 1906 to 1908, Greenleaf W. Pickard, of the United States, announced silicon, zincite, bornite-molybdenite, and chalcopyrite detectors. Studies made by Professor Pierce indicated that almost perfect rectification was obtainable from these detectors when contact adjustments were optimum. Further, the resistances of these detectors were very low in the conducting direction as compared with the carborundum detector, where several thousand ohms of "forward" resistance resulted in an appreciable loss in the received signal.

Following Pickard's work, a large number of

(Continued on p. 12)

DIME-NOVEL RADIO

Christopher Sterling

Vol. 13 No. 4, March 1973

When they were new, they sold for anywhere from 40 cents to $1.00 each. With their gaudy dust wrappers and exciting adventures, they sold well. Published in great numbers from 1890 to about 1950, the so-called "dime novel" was well entrenched and popular when radio hams were few and far between. As many AWA members have discovered, some of these boys' (and girls') titles dealt with telegraph, telephone, wireless radio - and even television. After buying a few for a song at a local bookshop, I spent more hours than I would have expected tracing down the lineage of those children's titles dealing with wire and wireless communications - and found that nearly 90 had been published by 1945.

Best known to most of us are Radio Boys, but did you know there were no fewer than four different series under that title, and there was even a Radio Girls series (equality is obviously nothing new)? There were Radio Boys series authored by Gerald Breckenridge (10 titles issued from 1922-31), Allen Chapman (13 titles from 1922-30), J. W. Duffield (five titles in 1922-24), and Whipple and Aaron's series of only two books issued in 1922. Margaret Penrose's Radio Girls appeared in four titles in 1922-24. But these and the many other radio-related titles issued in the early Twenties as broadcasting was having its initial boom were by no means the first wireless titles. "Capt. Wilbur Lawton" (a pseudonym for one John Henry Goldfrap) had penned six volumes about the Ocean Wireless Boys from 1914-17, and Lewis Edwin Theiss had published three titles in the Wireless Patrol series in the war years of 1917-19. But the honors for the first wireless-subject children's book must go (at this point, anyway) to John Trowbridge for his Story of a Wireless Telegraph Boy which appeared in 1908, just two years after Fessenden's Christmas Eve "first" broadcast. Indeed, Trowbridge gets honors for the first electrical communications subject children's book with his The Electrical Boy which appeared in 1891 and dealt with wired telegraph and telephone.

Easily as well known, however, are the individual wireless and radio titles which appeared in more general children's series. Probably the most famous of these are the relevant titles in Victor Appleton's (a pseudonym for Howard Garis of the Edward Stratemeyer syndicate) classic Tom Swift series, which in its 41 titles had a wireless-message story in 1911, a photo telephone detector by 1933. Richard Bonner's Boy Inventors had developed a wireless by 1912 and a radio telephone for 1915. In later years, the Motorcycle Boys, the Brighton Boys, the Golden Boys, the Boy Aviators, the Navy Boys - and even the Bobbsey Twins got involved with one volume in each series being built around radio. Not all the writers were mere hacks either - Trowbridge, of course, was best known for his physics work, and A. Frederick Collins (who wrote about Wireless Man in 1912) touted himself as the inventor of radio for years.

Nearly all of these titles followed a basic pattern of between 250 and 300 pages, a frontispiece drawing or painting (a few books even made use of photos), cheap paper and bright dustwrapper to attract attention; and most important, a story built around two or more young heroes or heroines who usually appeared in a series of anywhere from two or three up to over 30 titles. The writing was dragged out and often exaggerated and each chapter ended in a cliff-hanging situation which compelled youthful readers to finish that book and buy others in the series (which were enticingly advertised in the back of each volume).

Because production was quick and cheap, it is getting increasingly hard to find copies of these half-century old volumes, which were avidly read when new and badly treated for years thereafter. Today, they can be picked up for anywhere from ten cents (if you're lucky) to upwards of several dollars each (if the store owner knows what he has). Prices are increasing as the "dime novel" is grabbed up in the general nostalgia boom - and as radio historians realize the unique role of such books in portraying the importance of wireless and broadcasting to the generation that grew up with radio.

LET THERE BE LIGHT

Floyd Lyons

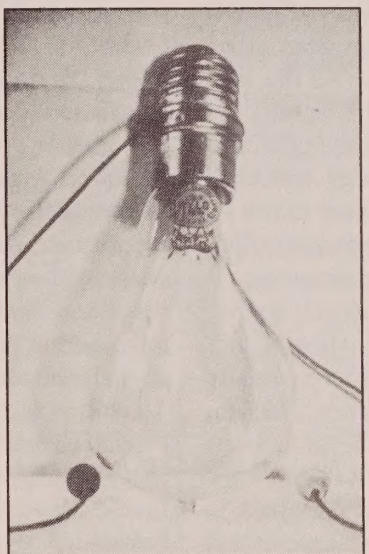
Vol. 4, No. 4, Winter 1963; and Vol. 5, No. 2, Summer 1964

There is a hobby in this country which cannot be extinguished. We are speaking of light-bulb collecting. This writer knows of only five serious, private collector-historians in the field (one lives in Australia).

There are still many interesting light bulbs to be collected, although the early ones are becoming more and more difficult to find. Of course, the Edison bulbs take on primary interest. To be added to this "Academy of Light" are such other famous brand names as Maxim, Sawyer-Man (forerunner to Westinghouse), Thomson-Houston (later to be General Electric), Schaefer, Heisler and Bernstein. There were roughly a dozen light-bulb companies flourishing in the U. S. by 1890. Competition was keen, and by 1900 these were narrowed down, mainly to the present-day major companies.

The first question asked by a visitor to my amateur museum is "How does one determine the age of a light bulb?" There are many broad rules of thumb. Here are but a few.

Prior to 1898, all bulbs were elongated or of short pear shape. Inside frosting did not commence until 1925. Generally speaking, the pinched top (tip) was discontinued about 1918. All lamps were rated by C. P. (candlepower) up through 1905. Hairpin-shaped bamboo filaments were used exclusively up through 1893. The filaments were fastened to the lead-in wires by platinum and nickel clamps in 1880; by copper-plated 1881-86, and carbon paste was then used up to 1918.



Rare double-filament bulb. Made in 1904, it has a unique feature: by pulling the strings one can obtain three settings - one C. P., 16 C. P., and out.

Rectangular labels with information as to C. P. and patent rights were pasted on the glass envelope up to about 1900. Round labels were in vogue after the turn of the century and usually included C. P. and voltage ratings.

Plaster of Paris was used in the base as insulation up through 1899; white porcelain was used in 1900 only; and the present-day black glass has been in use since 1901.

These are general rules. Much information as to age can be gleaned by scrutinizing the filaments of early light bulbs - shape, size and type. Other revealing factors come under getters and stem seals. An endeavor has been made below to cover the basics and to include interesting tidbits here and there.

FILAMENTS

1880 to 1893: Carbonized bamboo. These were, of necessity, hairpin-shaped. The length of the bamboo between ribs was not sufficient to allow even one extra loop. Also, bamboo fibers do not lend themselves to bending and/or twisting.

1884: "Squirted" cellulose was commonly adopted, although it had been invented six years earlier.

1899-1906: Osmium, invented by Welsbach. It was 75% more efficient than carbon. Used in Berlin and Vienna in small quantities. It was very expensive to manufacture due to the rare metal. This accounted for its short commercial life.

1905 to 1918: "GEM" came into being. It was a carbon filament coated with metal, 25% more efficient than the old straight carbon filament. The first Gem had two single hairpin filaments connected in series. The single oval came out in 1909. (Metals have a "positive" characteristic - that is, their resistance increases with temperature.) The Gem filament acts the same way, so it was called "General Electric Metallized" or Gem. This type of bulb was made for 110 volts only.

1906 to 1913: Tantalum. This was about 2.7 times as efficient as the Gem lamp. The metal in original form was impervious to water - was named after the fabled Tantalus who was condemned to stand up to his chin in water which constantly eluded his lips when he attempted to quench his thirst.

1906: Tungsten. At this early date, tungsten was not believed to be ductile - that is, capable of being drawn out and/or hammered thin. There was a great court battle on the subject of granting patent rights, with Just & Hanaman of Vienna finally winning out. This filament was also known as pressed tungsten.

1909: Mazda lamps. Mazda is not the name of a thing but the mark of a research service rendered to the manufacturers by the General Electric Co. at Schenectady. Their motto was "To make the best lamp possible at the moment." Therefore, many lamps by various companies were known as Mazda. The name was first used by GE, however.

1911: Drawn-tungsten bulbs were put on the mar-

ket after 13 years of experimenting.

1913: Coiled-filament gas-filled lamps were devised. These were the brain child of Dr. Langmuir of General Electric.

GETTERS

Definition: A "getter," as now applied, is any active agent used inside a bulb, either to assist in getting a better vacuum, or to improve the quality of the lamp - usually by preventing the blackening of the bulb. The getter era centered around 1912 to 1917. The two most famous getters were Skaupy and Needham.

The first use of a getter, although not known as such, was in 1894 by the Waring Electric Lamp Co., which manufactured the Novak lamp. The substance used was bromine vapor.

Malignani of Italy used phosphorus vapor two years later to obtain the same result. This system was so good that GE bought the patent rights for this country.

Skaupy getter: Certain chemicals were placed together in a cavity in the end of the glass arbor which supports the filament anchors. As the bulb heated, the compound broke up and formed a vapor which, in turn, reduced the blackening on the inner surface of the glass. This getter was used only in high-voltage lamps of 100 watts or more.

Fink getter: The chemical used was potassium iodide dropped on one end of the glass arbor. It was suitable only for 15- to 40-watt 110-volt lamps.

Needham getter: This was a combination of sodium and aluminum fluoride, made into a paste and placed on anchors supporting the filament, but not touching it. It was suitable for 25- to 60-watt lamps on a 110-volt supply.

Gill getter: Sodium chloride was dissolved in water and spread directly on the filament and mount. When heated, it deposited an invisible layer on the glass envelope.

Friedrich getter: Barium chlorate was placed in the hollow end of the glass arbor, much on the same order as with the Skaupy getter.

STEM SEALS

In 1880, lead-in wires were of platinum with glass "petticoats" around each lead. These, in turn, were sealed into the glass stem. The early 1880 models had a round glass seal. Late in the year, the petticoats were eliminated. The stem was flattened directly around the lead-ins; hence, were known as flattened seals. As time progressed and platinum prices increased, the platinum lead-ins kept getting shorter; copper wire connections were made thereto, with the connection welded directly inside the glass stem.

Nickel-steel was also used successfully in glass-filled lamps. Platinum was discontinued about 1911 and a nickel-iron alloy was used for the next two years. Then came 1913 and the advent of Dumet, an improvement of the aforementioned alloy. It had a nickel-iron core with a copper sheath and a borax coating.

It must be remembered that many of the steps of evolution described above were very short. Some of the changes came about so rapidly that little record was made. Some of the larger companies swallowed some of the lesser ones and all was not sweetness and light in said brotherhood. One must admit, however, that a lot of progress was made from 1880 to 1915 in light-bulb history.

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(Continued from p. 9)

minerals, mostly of a crystalline nature, appeared on the scene. Conducting solids of all kinds were tested in crystal cups and a goodly number worked to some degree. Silicon and galena, however, remained the most popular crystals as they were very sensitive and easy to find a "point" on. Some of the commercial wireless companies did not look upon the newfangled "catwhisker" arrangement with any great enthusiasm, particularly for use on ships. Vibration, strong signals and heavy static all contributed to "losing the point." In this period, ship operators, frequently faced with the prospect of a long trip on a ship equipped with the obsolete magnetic detector or, worse yet, a filings coherer, quite wisely took a piece of "coal" (carborundum) or their pet crystal detector along with them. In the rapidly growing group of amateurs, where extreme reliability was unimportant, crystal detectors were immensely popular. With an adequate antenna, a good tuner, and a pair of high-resistance headphones, they could receive spark signals, when good conditions, over hundreds of miles.

The crystal detector was not only the indispensable component for the early amateur and the commercial services, but was also the very heart of the million or so home-made broadcast lash-ups of the early 1920s, which comprised the base on which the present industry was founded.

The urgencies of World War I communications and the rapid advances in vacuum tube design had a tendency to relegate crystals to the status of components used in radio sets designed for children to play with from about the middle 1920s until perhaps 1941. Then the advent of radar and, later, the development of computers, brought about a very remarkable rebirth of this hardy veteran. Until the development of junction diodes, the basic design remained the same: a catwhisker on a crystal!

THE CHARGE OF THE LIGHTNING SENDER

Bruce Kelley

Vol. 17, No. 4, March 1977

Some of you may have heard about the remarkable achievements of old-time operators who could copy two different messages simultaneously by writing with both hands, or the fellow copying in Spanish and typing finished, translated copy on the "mill" in English at 45 wpm - or handling up to 60 messages per hour. I have actually witnessed the last two.

The great operators of the past were landline railroad telegraphers, stock-brokerage, and Western Union employees. They used the original Morse code, whereas we use International Morse for radio. Fifteen of the Morse code letters are the same as International, while the other 11 are different, as are most of the punctuation characters and numbers.

Until the advent of the typewriter ("mill"), real Morse telegraphers copied all messages with pen and ink in beautiful longhand. In the AWA Museum are several examples of early telegrams. A good penman could write 30 to 35 wpm solid in deliverable copy, while a good operator using the mill could take 50 to 60 wpm without expending himself.

What's the trick? Copy behind, naturally. Most commercial operators handling straight text always copy about five words behind. Code groups is another story. This all leads up to a little poem I found about a "plug" who copied behind. The term plug was the name given to early landline telegraphers who blindly stabbed their pens at the inkwell. An early telegrapher never copied each character as received. He always copied behind, carefully dipping his pen in the inkwell - for obvious reasons if you've ever used pen and ink. Now for the poem about a plug on a dark night long ago.

THE CHARGE OF THE LIGHTNING SENDER

Up from his chair the other day,
A plug arose in some dismay,

To answer a call from a distant town,
On a wire difficult to hold down,

The office was warm, the hour was late
As that sender started at rapid rate,

And soon he was going like the wind
With the plug about fifteen words behind.

And faster and faster the dashes rolled,
And the dots like a torrent uncontrolled,

'Till through that office seemed to pour
Some sixty words a minute or more;

And there in the dim and waning light -
Driving his pen with all his might -

With lips compressed, to his desk inclined,
Sat the plug, twenty words behind.

Then swift from his pen the hot words flowed
Like chicken tracks in a muddy road;

And as he thought of his terrible need,
He scratched away at his utmost speed:

And soon on his face came a pleasant smile,
For he had caught on to that sender's style;

And as dots and dashes came to his mind,
He soon was not more than ten words behind.

Onward, still onward, at steady pace,
The plug surely was winning the race.

And when a long "special" neared its end,
He knew full well that the sender could send.

Sometimes ahead, sometimes in the rear,
At last every word to him came clear.

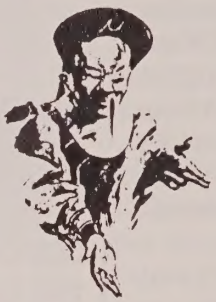
And when they got through, bear this in mind
The *sender* was fifteen words behind.

THE GREBE RADIO STORY

G. J. Gray, W8JDV

AWA Monograph No. 6, Vol. 3, No. 4, Winter 1962-63

Remember the Grebe ads in QST in the early 1920s? They featured the venerable and wise Chinese gentleman Dr. Mu, explaining why we should buy Grebe equipment. Grebe craftsmanship, pointed out by Dr. Mu, was evidenced by solid, quarter-sawn, stained oak cabinets, satin-finished bakelite panels, polished molded dials, rigid bus wiring; all expertly assembled to produce a high-quality radio receiver.



Alfred H. Grebe was born at Richmond Hill, Long Island, in 1895. He later established a modern radio plant at the town of his birth. Like a lot of us, he started "tinkering" with radio at an early age. At 14, he built a small workshop in his mother's backyard and started building exceptionally good loose couplers for his experimenter friends. Thus, in 1909 a small business was started which was destined to have a great impact on the radio field.

In 1911, about the time Grebe's contemporaries started college, he chose the romantic life of a seagoing wireless operator, touring the oceans as "Sparks" for three years. The Orient held a special interest for him and may account for the Dr. Mu ads in later years. His experiences as a wireless operator with crude commercial spark equipment of the time gave him practical knowledge of what it took to communicate under all conditions.

Late in 1914, Grebe served as chief wireless operator on the S. S. Satanta, call GTG, a tanker under British registry. Ralph Barber, W2ZM, later executive secretary of QCWA, was second operator. After a nine-month trip around the world, Grebe and Barber resigned at San Francisco and came back to New York by train. A German submarine later sank the ship in the Indian Ocean and all hands were lost.

When he came home, he found a change had taken place. Three years earlier few knew or cared about radio. Now, he found people interested in the fast-growing science. Friends asked him to build receivers and amateurs asked for help with their transmitters. Grebe did not have a college degree but had a natural talent in the design and construction of radio equipment. With his talents so much in demand, he started building equipment for sale and issued a small catalog. As the market for high-quality radio gear increased, the Grebe plant grew until in 1926 it housed facilities for producing 10,000 receivers.

During the summer of 1916, Grebe had a contract with E. J. Simon & Co. to install radio equipment on French anti-sub boats. Grebe and Barber installed the gear at Anacostia Naval Station.

Grebe built receivers with the letters AGP before the model number. The letters stood for Armstrong-Grebe-Pacent: Edwin Armstrong for regeneration, Grebe the manufacturer, and Pacent of Manhattan Electric Supply for ideas and merchandising the line. Pacent marketed the receivers through his company under the MESCO name. The AGP 101 sold for $32.50 in 1916. John Di Blasi, W2FX, later president of QCWA, was manager of Manhattan Electric Supply.

In 1917, the Grebe Company designed and built special receivers for use on U. S. Navy subchasers, with dials radium-marked for visibility when sailing without lights to prevent detection by enemy ships.

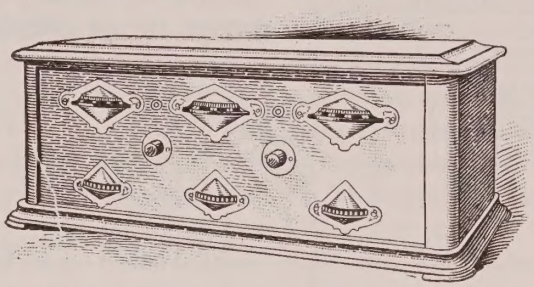
Grebe had built the now-historic loose coupler to function with the crystal detector. Later, the vacuum tube replaced the crystal, and vario-couplers replaced loose couplers. Variometers were added to tune the grid and give smooth regeneration control in the plate circuit. Every part of the Grebe receiver was designed and built to high standards of quality.

Here, the principle went into practice of doing small things well to accomplish great things. Metal sheets and rod became carefully made condensers and small metal fittings. Finely powdered bakelite, molded under great pressure and heat, became solidly built variometer frames, sockets, condenser frames and dials. Skilled forming and electrochemical processes turned aluminum into satin-smooth parts. Everything was built in the Grebe plant with high engineering standards and talented workers to produce the finest in receivers. These receivers were an inspiration from a brilliant mind associated with many of the foremost inventors of the time.

To the Grebe plant came Stuart Ballantine, John Hogan, Major Armstrong, Dr. Ben Liebowitz and others to make their contributions to a fine product. Alfred Grebe was a tireless experimenter who was responsible for many advances in radio design. If an idea occurred to him at four o'clock in the afternoon, the engineering staff would stay up all night until the "breadboard" model was constructed and some results were obtained. The experiment was continued until a complete receiver

with all refinements and wonderful workmanship was built.

Bill Diehl, then chief engineer, recalls how at five o'clock in the afternoon, having finished work in the lab, he would check the production line and find 20 or 25 receivers ready to be tested. He would spend the evening testing them by listening to signals. He would tune the band, checking for dead spots and testing the sensitivity on signals from California, New Zealand, Australia, Rome, Bordeaux and other DX stations. His first lab equipment was a wavemeter made with a Seibt condenser, coils, and a hot-wire galvanometer. (Grebe's secretary at that time, now Mrs. Wm. Diehl, tells how Major Armstrong came in one day dressed in old clothes and she sent him to the employment office for a job!)



In 1919 the famous CR-series started with the CR-1 one-tube "shortwave" regenerative receiver. Wavelength range was 170 to 680 meters. No one talked in terms of kilocycles then. The CR-1 had a rotary coupler with unit-tapped switches for the primary, two variometers (one in the grid circuit, the other in the plate), a vacuum-tube socket mounted in the panel, a filament rheostat and the necessary binding posts and connections. UV-200s, WE VT-1s and Audiotrons were used for detection. A small fixed condenser was provided to increase the normal wavelength of 170-375 meters to a range of 280-680 meters by switching the condenser into the circuit. The VT socket was made of seamless brass tubing, finished in satin nickel and held in a recess at the rear of the panel by a bracket. The 1919 CR-1 sold for $100. This and all subsequent Grebe receivers were licensed under the Armstrong and Marconi patents.

The other Grebe receivers of that year were based on the CR-1 design. The CR-2 was a tuner only, without detector socket or filament rheostat and with one tap switch on the primary inductance. The CR-3 was a special "relay man's receiver" with a range of 150 to 680 meters. The CR-4 was built upright and had a variable series condenser in the antenna circuit.

More elaborate receivers, the CR-6 and CR-7, were also in the line. The CR-6, covering a range of 170 to 680 meters, had the basic CR-1 circuit with a series antenna condenser and a variable shunt condenser across the phone circuit for smoother regeneration control.

The CR-7 was a long-wave receiver covering the range from 500 to 20,000 meters. This was an elaborate set with a 12" x 21" panel, a detector tube socket mounted on the panel, a variable series antenna condenser, a secondary variable condenser, and efficient litz-wound windings in two, four and six banks to obtain the proper coupling and inductance values. For wavelengths above 2200 meters, special concentrated inductances were used. The 1920 catalog said, "Evenings may be spent listening to high-power longwave stations in France, Germany, Italy, Britain, Japan and even Russia." It listed crystal detectors, tube detectors, one- and two-stage audio amplifiers, unit variometers, unit condensers, fixed condensers and rotary synchronous spark gaps.

The Grebe Company developed and held patents on automatic filament control, molded bakelite variometers, rheostats calibrated in ohms, tangent-wheel verniers, tapered-grip dials and a unit form of shielding. The automatic filament control gave the operator instant choice of detector, detector and one stage, or detector and two stages of amplification. The plug energized only the filaments of the tubes in actual use.

The line in 1923 incorporated all these improvements. The CR-8 selling for $135 replaced the CR-1, but the circuit was the basic variocoupler and two variometers, with refinements to extend the range. This receiver, tuning from 150 to 1000 meters, was an instrument to brighten the life of any relay man. The CR-5, the first single-circuit receiver with a range of 150 to 3000 meters and two-dial control, was designed for the user who wanted simple control and wide range. It was tuned by a series antenna condenser and a ten-section, triple bank-wound inductance in series with the stator winding of a variometer. The rotor of the variometer was in the plate circuit for smooth regeneration control. The CR-9 added a two-stage amplifier to the CR-5 circuit.

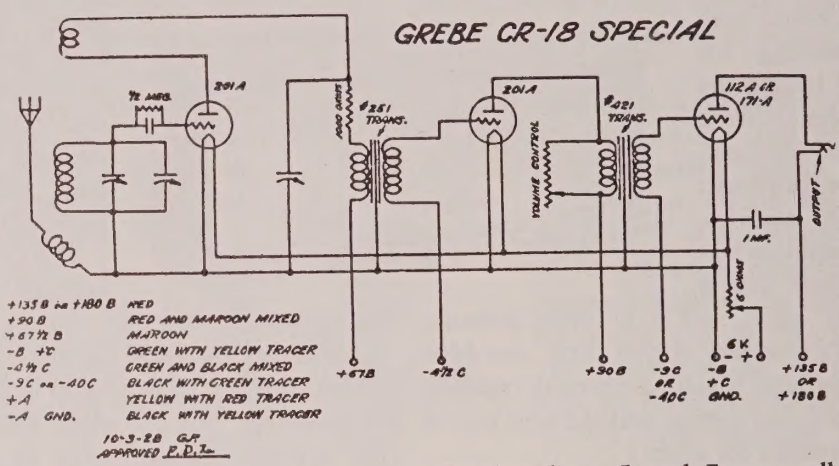
The first tuned radio frequency amplifier on the market was the Grebe RORN, which provided excellent signal strength with only a loop or short pickup wire. A vacuum tube with a tuned circuit was coupled to a standard regenerative receiver. Trouble developed due to RF feedback but, by using proper grid-leak and input capacitor combinations, Grebe was able to get adequate gain over the simple regenerative circuit.

Amateur exploration into the shorter wavelengths was recognized in the CR-13 design, which incorporated tuned radio-frequency amplification with regeneration in the detector plate circuit. The CR-12 and CR-14 were broadcast receivers with a range of 200 to 600 meters, housed in beautiful walnut cabinets.

The CR-18 was the last of an illustrious line designed especially for the amateur. Following the trend to shorter wavelengths and efficient low-loss

coils, the CR-18 had plug-in coils, regeneration, and one audio stage with horizontal dials projecting through gold escutcheon plates on the panel.

Grebe equipment went to the South Pole on Byrd's first expedition. Two early broadcast stations, WBOQ and WAHG, were built and operated by Grebe. WAHG later merged into WABC. The first "marine broadcast" station, WRMU, which was used to put yacht races and other marine events on the air, was installed on MU-1, the yacht of Douglas Rigney, general manager and treasurer of the Grebe Company.


GREBE CR-18 SPECIAL
201A
201A
112A OR 171-A
+135 B OR +180 B RED
+90 B RED AND MAROON MIXED
+67½ B MAROON
-B +C GREEN WITH YELLOW TRACER
-0½ C GREEN AND BLACK MIXED
-9 C OR -40 C BLACK WITH GREEN TRACER
+A YELLOW WITH RED TRACER
-A GND. BLACK WITH YELLOW TRACER
10-3-28 GR
APPROVED P.D.T.

WRMU had two oscillator tubes, two modulator tubes and power of 100 watts. When operated as a relay for WAHG a wavelength of 68 meters was used. For broadcasting directly to listeners, the wavelength became 236 meters. A motor generator operating from a 32-volt bank of batteries supplied 1500 volts for the plates.

In 1928, Grebe equipped the yacht, Fan Kwai, with a transmitter for phone and ICW operation between 40 and 130 meters. The receivers were a CR-18 for short waves and a Synchrophase 5 for broadcast reception and phonograph amplification. A station, manned by Lloyd Jacquet, was installed on the S. S. Aquetania to test ship-to-shore short-wave communication.

The first mobile transmitter WGMU, with a power of 100 watts was installed in a car and used to broadcast horse races (much to the disgust of the local bookies!). It was also used for other remote pickups.

Amateur station 2LH had been operated by Al Grebe in 1912, handling a lot of relay traffic at that time. Experimental station 2PV became 2ZV and in 1916 operated with rotary spark and 500-cycle quenched gap. An arc telephone transmitter with special Grebe receiver made an imposing installation. Later, experimental station 2XE operated on wavelengths as low as 10 meters and included CR-6 and CR-7 receivers. Ted Ostman, then director of Grebe Service, was 2OM. He won the 1922 Hoover Cup for excellence in amateur design and operation. A picture of station 2OM taken in 1921 shows a CR-13 and two-stage amplifier. A husky one-kW transmitter with Grebe rotary synchronous spark gap and oscillation transformer with a single-turn primary made of three-inch copper strip was used. A sturdy wavemeter and loop-modulated phone setup completed the station. Contrast this solid bulky gear with streamlined, efficient tabletop gear of today.

In 1926 receivers designed for broadcast use featured the Synchrophase circuit with "binocular" coils designed to prevent interaction between stages. The patent rights on these coils started a lengthy legal action between Grebe and Hazeltine, who, however, remained good friends during the legal proceedings.

The Synchrophase MU-1, Synchrophase 5 and 7 were all popular battery broadcast models which later used Grebe "A" and "B" eliminators for AC operation. The last models were self-contained AC sets featuring "Colortone" audio control and single-dial tuning. Rich mahogany and walnut cabinets housed this fine equipment.

Grebe, the perfectionist and practical, self-trained radio engineer, was a shy, modest man concerned with producing only the very best in radio equipment. He surrounded himself with such capable men as Bill Diehl, Ted Ostman, and Douglas Rigney. We can only wonder how far the Grebe Company would have gone if there had been no Depression in 1929. This economic collapse reduced the market for high-quality receivers and the company was liquidated in 1932.

In 1935, Grebe completed plans for a new company with a 1936 line of receivers. However, he had a serious operation on October 24, 1935. Complications developed and Alfred H. Grebe, W2ZG, became a Silent Key.

ABOUT THE AUTHOR

Jack Gray, W8JDV, was unquestionably the country's foremost Grebe historian until his death in 1970. Unlike most collectors, he decided to specialize and selected Grebe as his subject.

W8JDV started in the game well before WW I. Originally a Marconi commercial operator in South American and European waters, he finally settled down and after formal education landed at the Crosley Corporation, and was with them for almost 40 years. Formerly on the WLW staff, he was for 19 years an engineer at their super-power Voice of America installation. An old-time ham (ex-8ARP), he could be heard regularly on SSB and was active in the QCWA, OOTC, and AWA.

THE STENODE - REVOLUTIONARY DEVELOPMENT 40 YEARS AGO

Bruce Kelley

Vol. 12, No. 2, Sept. 1971

In the fall of 1930 a paper was delivered to the Radio Club of America by British scientist Dr. James Robinson. His talk covered the development of a new method to improve receiver selectivity and minimize interference. The key to his system was a quartz crystal in the IF section of a superhet receiver.

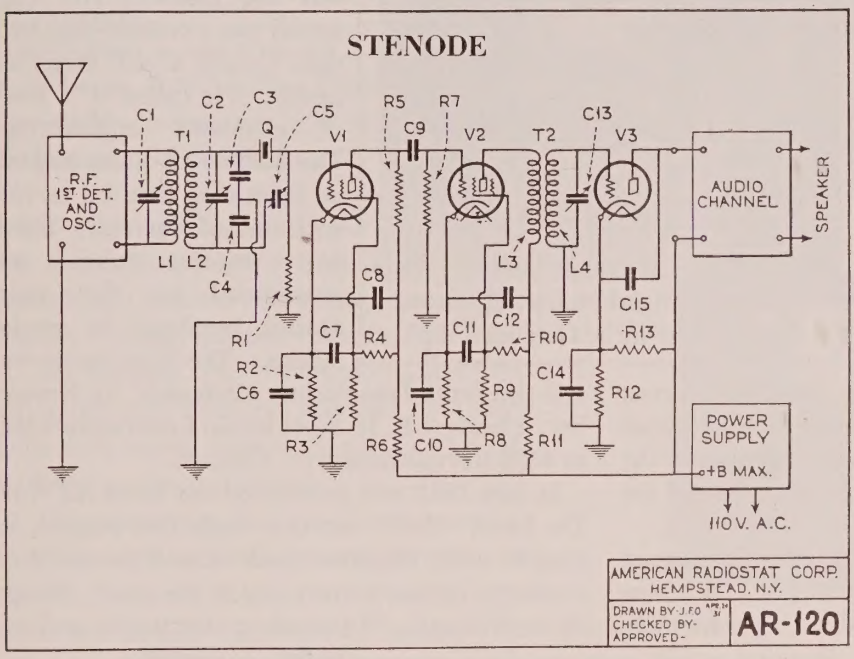
We are all now familiar with his dramatic disclosure - the crystal filter so popular in amateur receivers for many years. The first writeup appeared in the October 1930 issue of *Radio News*, followed by others in the February and March 1931 issues.

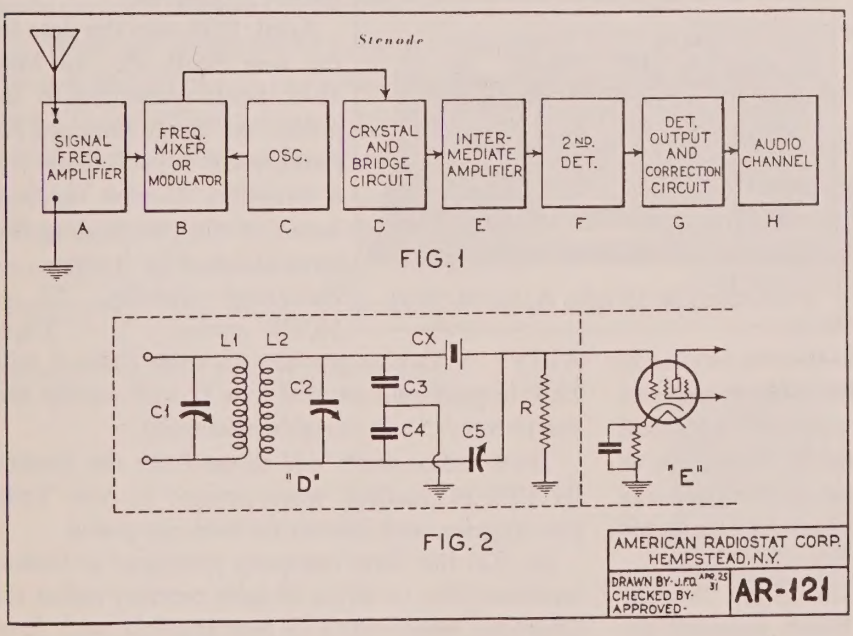
Several companies were formed to manufacture the receiver, the Stenode Radiostat. Foremost were Stenode Corp. of America, American Radiostat Corp. and the British Radiostat Corp.

Just what happened to these companies is not known except that shortly afterward several receiver manufacturers came out with sets incorporating a crystal in the IF for selectivity. One of the first ham sets was the National FB7-X, with "X" indicating the crystal filter. Others followed, including Hammarlund and Hallicrafters.

The early Stenodes had a crystal cut for 175 kHz. However, in time, the frequency was increased to 455 kHz. An unmounted crystal sold for $10 and units mounted in a glass bulb sold for $15.

The latter was most popular and had a standard four-prong UX base. One side of the crystal holder went to the plate prong and the other to a connection at the top to reduce electrostatic capacity. The National Company sold a complete line of components enabling the home constructor to incorporate the principle in his super, providing it had a 175-kHz IF.





When first announced, there was much interest, since some proponents felt that if all broadcast receivers used the filter, the number of broadcast stations could be increased. With WJZ on 760 kHz, a demonstration showed two other stations could broadcast within five kHz (755 and 765 kHz) without interference.

Needless to say, this never materialized, although great attempts were made to show there would be little loss in performance with such operation.

Arthur Lynch, one-time editor of *Radio News*, was frequently associated with Stenode promotion. The AWA Museum displays two historical Stenodes, the latest received from Bill Laverty who contributed information for this article.

[Riders Vol. 1 (page M-1-18) shows an early version of the Stenode Radiostat with battery tubes and loop antenna. - Ed.]

THE SCOTT RECEIVER STORY

Earl England

Vol. 7, No. 1, Spring 1966

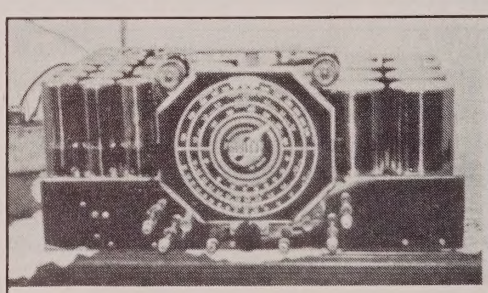
"Massive," " beautiful," and "a great performer," describe the Scott receiver.

E. H. Scott apparently started in business in the year 1924. The earliest ad that I can find is in the *Citizens Radio Call Book* of September 1926, where he advertised "Selectone Long Wave Transformers as used in the World's Record Super 9." The firm at that time was Scott Transformer Company. The December, 1926, issue of *Citizens Radio Call Book* had a two-page spread on the Scott "World's Record Super - Radio's Greatest Receiver." This set reportedly established a new world's record for consistent reception, night after night, of stations at 6000 miles or more distance.

Imperial High-Fidelity All-Wave (French Provincial Cabinet), 1935.

In March 1927, Scott added an extra stage of intermediate frequency, which he claimed "Greatly improves this popular receiver." In September of the same year, Scott announced "Radio's Greatest DX Receiver - The New World's Record Super 10." For November, the company introduced the "World's Record Super 8," an economy model for the year 1928.

The following January, Scott and Thordarson brought out a full-wave power supply and a new 210 power-output stage, and added a phono pick-up to the popular "World's Record Super 10." In March, Scott challenged the whole world of radio to any kind of competitive test with his new "Shield Grid World's Record Super 9." As of September, the company announced a new "World's Record Shield Grid 9," new power supply and amplifier using a 250 power tube. The ad said "can be built by anyone in a few hours." In November, the "World's Record Screen Grid 9-B" was battery operated and used plug-in coils to cover 20-50 and 35-90 meters as well as the broadcast band. Scott at this time was advertising for custom set builders to construct his sets.



Philharmonic 33-tube AM-FM, 1941.

In January, 1930, Scott announced the "World's Record Shield Grid A-C 10" which featured the Scott remote control. At this time he was still selling sets to enterprising custom builders.

In January, 1931, was announced the "All Wave" in which Scott outdoes Scott in power, selectivity and tone! This was the first of the Scott Classic sets and still is a beautiful receiver. Chassis, tube shields, coil shields, transformers, etc., were chrome-plated. In fact, all Scott receivers from this time on were chromed with the exception of the few made during WW II. The workmanship was the finest. The 1931 model was a custom-built two-dial, 12-tube, 15-550 meter superhet. He called it "a jewel of advanced engineering." This set and all others produced from that time on carried an iron-clad warranty. Every part except tubes was guaranteed for five years against breakage or service failure. The firm name was still the Scott Transformer Company. In November, it became E. H. Scott Radio Laboratories Inc., at 4450 Ravenswood Ave., Chicago.

In July, 1932, was announced the "Scott All Wave De Luxe," 15-550 meters, single-dial control, no plug-in coils! He advertised "around the world reception a certainty every day in the year." Weight of tuner chassis, 38 pounds; power supply and amplifier, 20 pounds.

April, 1934, was the date for the new Scott 15. In May, 1935, Scott presented to the public the "Scott Imperial Hi-Fidelity All Wave." This was a beautiful 23-tube receiver. Some of the outstanding features claimed for it were: • Full-range fidelity, 25 to 16,000 cycles; • Triple AVC; • Surplus power: 35 watts Class A with 2A3s in push-pull-parallel to a 12-inch woofer and two tweeters; • Variable selectivity.

Scott radios were sold direct from the factory. By 1935-36 "studios" were opened in New York, Los Angeles, and Detroit for sales purposes.

In 1936 the Scott company produced in limited numbers (five or six) a 40-tube receiver called the Quaranta, which was a de luxe Imperial with three

(Continued on p. 39)

VINTAGE VLF/ELF VACUUM-TUBE RECEIVERS, 1918-1962

Harold A. Layer, KK6HY

Vol. 19, No. 3, Dec. 1978

The directory on the next page is an attempt to list every vacuum-tube radio receiver that could tune within the VLF band of 3 to 30 kHz or the ELF band of 3 Hz to 3 kHz. Radio began in the long-wave spectrum and the importance of these remarkable sets for military defense, RFI studies, and scientific research cannot be over-estimated.

For years, many long-wave receivers were state-of-the art military secrets; consequently, information about them is difficult to obtain. Not included in this list are fixed-channel sets, untuned sferic direction finders, and low-sensitivity tunable voltmeters.

Corrections or additions are welcome. Write to H. Layer, Audio-Video Center, San Francisco State University, 1600 Holloway Ave., San Francisco, CA 94132.

Notes:

1. The earliest date that I could find or guess is listed. If a receiver had minor changes identified by a model-number, only the first is listed. For example, the 1945 RAK-7 looks identical to the 1935 RAK, but was built by Andrea Radio with newer tubes. However, the RO and RO-2 are quite different.

2. The selectivity of early VLF receivers was often improved by an audio bandpass filte.. Its resonant frequency is listed when known. The selectivity of later receivers is indicated by their narrowest specified bandwidth.

3. Tubes are numbered as follows: "33-4/4-1" means the set has 33 tubes and four diodes in its RF and AF circuits, and has four tubes and one diode in its power supply.

4. "AC" means the receiver has a built-in AC power supply. "AC" indicates that a separate power-supply unit was available. "B" denotes battery power. "DC" means DC power.

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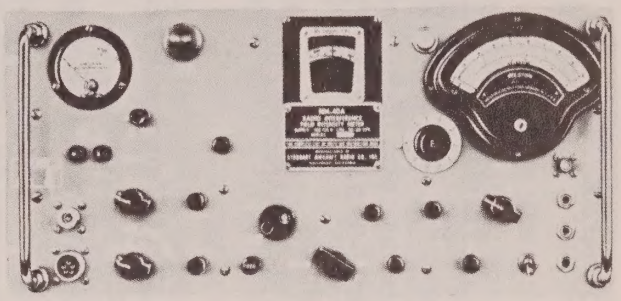
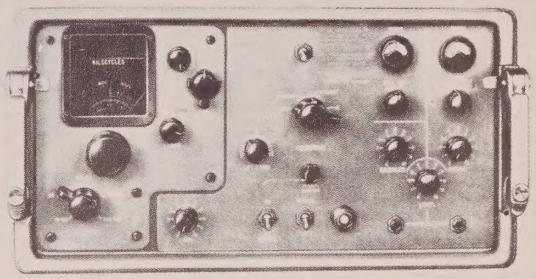
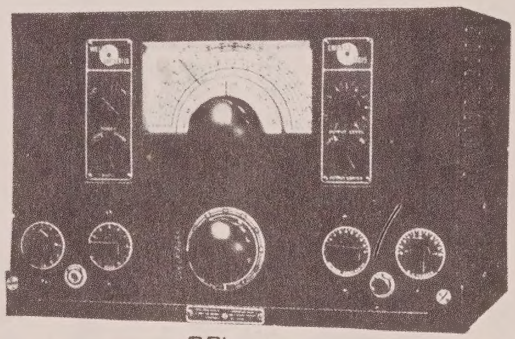


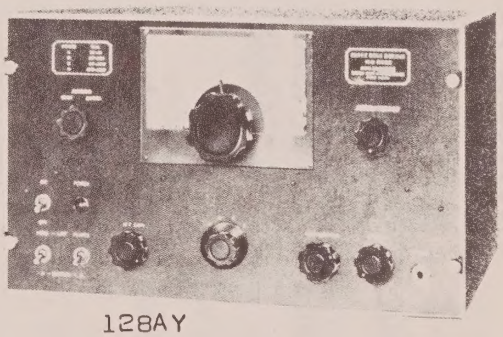
NM-40A - First ELF Superhet
This was the first receiver to tune below 10 kHz.



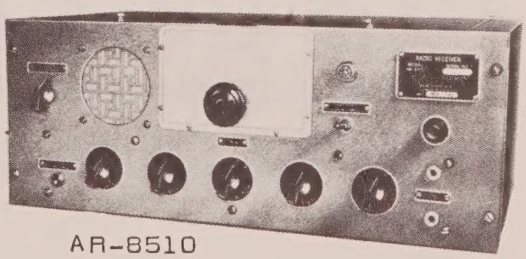
AN/SRR-11



RBL



128AY



AR-8510

VINTAGE VLF/ELF VACUUM-TUBE RECEIVERS, 1918-1962

Harold A. Layer, KK6HY

DATE	MODEL	MAKE	TUNING	SELECTIVITY	LBS.	TUBES	PWR.	FEATURES
~1918	**SE-1617**		18-43 k			6		TRF; 3 RF stages; reg. det.; 2 AF stages.
~1920	**IP-501, IP-501A**	WSA, RMCA or AMRAD	15 k-1.2 M	Var. coupling	55	3	B	TRF; reg. or xtal det.; uses IP-503 long-wave loading unit for 15-37.5 kHz range; 2 AF stages.
~1921	**RA**		16 k-1.2 M					TRF; submarine use.
~1921	**RB**		10-50 k					TRF; requires SE-1530 receiver unit.
~1922	**110** (Universal)	Kennedy	12 k-1.7 M	Var. coupling	27	1	B	TRF.
~1922	**RD**		12 k-1.2 M					TRF.
~1925	**RE**	NRL	10-100 k	Audio filter		6		TRF; uses SE-1834 RF amp. with 3 peanut-tube stages; reg. det.; 2 AF stages.
~1925	**SE-2300**	NRL	10 k-2.3 M			4		TRF; 1 RF stage; reg. det.; 2 AF stages.
~1926	**RK**		12-375 k					TRF.
~1929	**RQ** (CAY-3355)	Westinghouse	15k-1.0M	700-Hz audio filt.		5	B	TRF; 3 RF stages; reg. det.; plug-in coils; HF twin is CAY-3356.
1930	**RO** (CG-3362)	GE	15 k-1.0 M	500-Hz audio filt.	100	6	B	TRF; 2 RFs; heterodyne det. <45 k, autodyne det. above; plug-in coils, HF twin.
1930	**RO-2** (CAY-3940)	Westinghouse	15 k-1.0 M	800-Hz audio filt.	60	7	B	TRF; 4 RF stages; reg. det.; plug-in coils; HF twin is CAY-3941.
1931	**RAA**	RCA	10 k-1.0 M	1-kHz audio filt.	465	11/3	AC	Superhet; 1 RF stage; 2 IFs with 4 switched IF freqs.; AVC; BFO; HF twin is RAB.
1932	**RAC**	NRL	12-80 k	800- & 1000-Hz filts.	170	7/2	AC	TRF; 3 RF stages; heterodyne det.; 2 AF stages; requires SE-4511 RF amp/det. unit.
1932	**GK-1**	Westinghouse	15 k-1.0 M			7	B/AC	TRF; plug-in coils.
1933	**RAG** (CHS-46042)	Sylvania	15-600 k	Multi-f audio filt.	93	8/1	B/AC	TRF; 3 RFs; heterodyne det.; variable AVC; HF twin is RAH.
~1935	**AR-8500**	RMCA	15 k-1.7 M	Fixed bandwidth		4	B	TRF; 1 RF stage; reg. det.; plug-in coils.
1935	**RAK**	RCA	15-600 k	Multi-f audio filt.	116	6/2	B/AC	TRF; 2 RF stages; autodyne det.; variable AVC; HF twin is RAL.

1938	**CXS**	Bendix	15 k-1.5 M			10	DC	Superhet; direction finder; 1 RF stage; 2 IFs; BFO; omits 70-100 kHz range.
1939	**DZ** (ADF)	RCA	15k-1.5M	1020-Hz audio filt.	37	8	DC	See notes on CXS.
1939	**RAZ** (AR-8503)	RMCA	15-600 k	Fixed bandwidth	29	4/1	B/AC	TRF; 1 RF stage; reg. det.; optional presel.
~1940	**117B**	Mackay	16 k-20 M	Fixed bandwidth		5/1	B/DC	TRF; 1 RF stage, reg det.; plug-in coils.
~1940	**128AY** (R-212/SR) RC-123	Federal	15-650 k	Fixed bandwidth	43	5/1	B/AC	TRF; 1 RF; 1 RF regenerator; grid-bias det.
1940	**RBA**	Federal	15-600 k	1-kHz audio filt.	147	8/2	AC	TRF; 3 RF stages; heterodyne det.; BFO; variable volume limiter.
1941	**RBL**	National	15-600 k	Var. to 600 Hz	75	6/1	B/AC	TRF; 2 RF stages; reg. det.; var. vol. limiter; HF twins are RAO & RBH.
1942	**AR-8510** (R-215/SR)	RMCA	15-650 k	Fixed bandwidth	39	5/1	B/AC	TRF; 2 RF stages; regenerative det.
1943	**BC-969** (SCR-614)	Majestic	15-150 k	Variable BW	119	11/2	AC	Superhet; 1 RF stage; 2 IFs, xtal filter; AVC; BFO; noise limiter.
1949	**NM-10A** (AN/URM-6)	Stoddart	15-250 k	Var. to 100 Hz	51	16/5	AC	RFI - lab superhet; 1 RF stage; 3 IFs; AGC; BFO; calibrator.
1950 1954	**AN/SRR-11** (R-439) **AN/FRR-21** (R-105)	RCA	14-600 k	Var. to 300 Hz	65	24/3	AC	Superhet; duo-conv.; 2 RFs; 4 IFs; BFO; noise & output lims; xtal calib.; submin. tubes; HF twins are SRR-12 and SRR-13.
1954	**R-389/URR**	Collins	15 k-1.5 M	Var., 100 Hz - 8 kHz	70	30/7	AC	Superhet; duo-conv.; 2 RFs; 6 IFs; xtal osc.; AGC; BFO; var. noise lim.; digital tuning; HF relatives are R-390 and R-391.
1956	**NM-40A** (AN/URM-41)	Stoddart	0.03-15 k	Var., 8-60 Hz	120	33-4/4-1	AC	RFI - lab superhet; 3 RFs; quad diode bal. mixer; 4 IFs; BFO; AGC; calibrator.
1956 1956	**SP-600VLF** **Dero 2F**	Hammarlund Dero	10-540 k	Var, 0.2-6 kHz	70	17/4	AC	Superhet; duo-conv.; 2 RFs; 3 IFs, xtal filter; noise lim.; BFO; AVC; HF twin is SP-600.
1960	**AN/BRR-3** (R-988)	Federal (ITT)	14-30 k	Var BW to 60 Hz	75	26/3 17 diodes	AC	Superhet; single-conv.; 3 RFs; 5 IFs; BFO; AGC; noise lim.; CRT display; digital tuning.
1961	**NF-105/TX** (AN/URM-7)	Empire	14 k - 1 G	Fixed bandwidth	70		AC	RFI - lab superhet; calib.; 5 plug-in tuning modules with different IF stages.
1962	**AN/WRR-3** (R-1134)	Magnavox	14-600 k	Var. BW to 350 Hz	70	16-4/5	AC	Superhet; duo-conv.; 2 RFs; 4 IFs; BFO; noise & output lim.; xtal calib.; digital dial.

HISTORY AND DEVELOPMENT OF THE ALL-METAL RADIO TUBE

Bro. Patrick Dowd, W2GK

Vol. 16 No. 4, March 1976, and Vol. 17 No. 1, June 1976

Copyright (c) 1976, 1992 Bro. Patrick Dowd

AWA is proud to be able to print the first serious historical research on the development of the all-metal tube. The author made numerous field trips and interviews to obtain firsthand, reliable information. Members attending the 1975 Conference saw his original documentation. -BK

INTRODUCTION

Although orphaned shortly after birth when, conceived by one company, she was raised by another, this spunky little tube not only survived but lived to make history. Her birth ushered in the modern age of tube technology when the umbilical cord binding her to an incandescent-lamp heritage was severed. History positioned her arrival mid-way between the birth of the vacuum tube and its incipient decline. The announcement of her birth sparked more publicity and controversy than any prior or subsequent tube. It is ironic that the very technology that occasioned her birth and cured her childhood ills was ultimately to cause her demise.

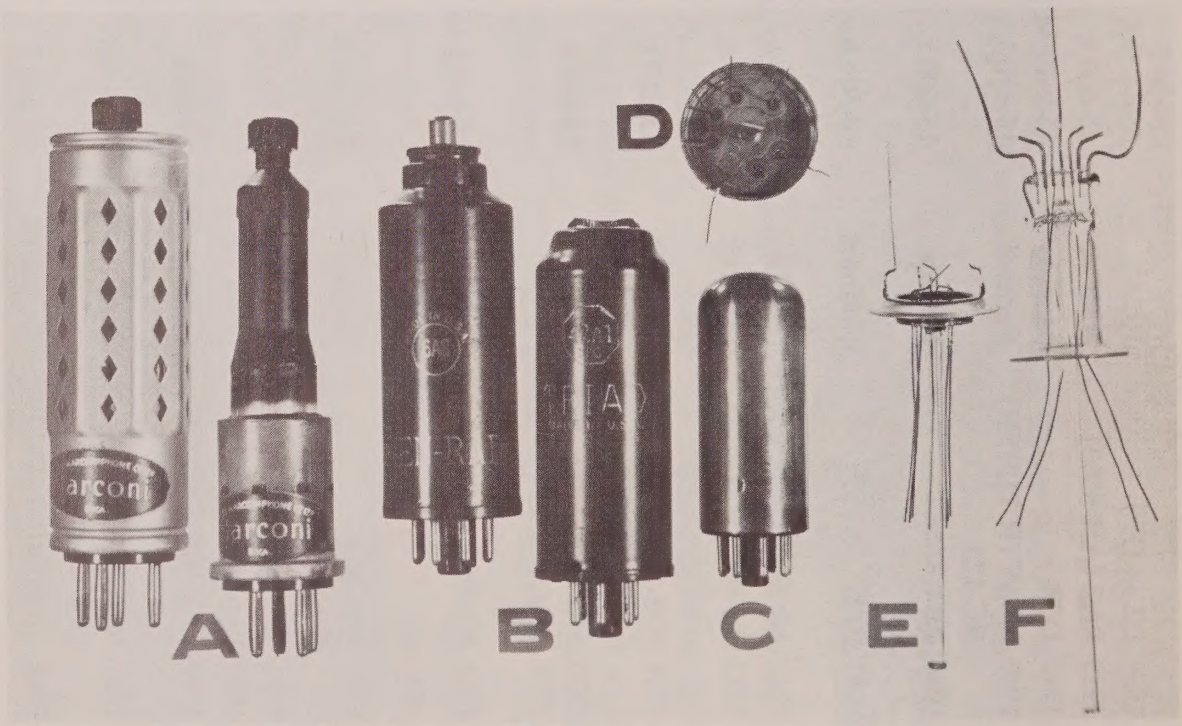
Unfortunately, this "Depression baby," after a history-making childhood, a dedicated adult life, and distinguished service in WW II, was all but forgotten in later life. It is only fitting that, in her old age and before death of her species, the "plain Jane" of the tube world, long neglected by collectors and historians alike, be restored to her rightful place in history and be given some of the recognition denied her throughout adult life.

DEVELOPMENT HISTORY

The all-metal tube made its debut 40 years ago last September. It was originally conceived as a unique selling point to mark the return of the General Electric Company to the receiving-tube and radio-receiver fields after an absence of five-and-a-half years. GE timed its re-entry for the fall of 1935, when it planned to unveil its new receiver line featuring its "eternal" all-metal tube.

The GE engineers developed the idea of the all-metal tube, which was to be unbased and wired directly into the set, and planned to make it so durable that it would last the life of the receiver. Although they had initiated and perfected most of the early manufacturing techniques, GE was unable, because of long absence from this field, to produce the all-metal tubes economically and on time. Consequently, they turned over the manufacturing job to RCA on October 9, 1934.

To place the above remarks in perspective, it is necessary to go back to the late Twenties when radio's Big Four – RCA, GE, Westinghouse and AT&T (Western Electric) – engaged in some hard-nosed negotiations designed, for economic reasons, to prevent needless duplication of research and manufacturing efforts and to avoid unnecessary competition.



A: Marconi Catkin tubes. B: Ken-Rad and Triad MG tubes. C: Bullet-tube prototype. D: Early eyelet-type metal-tube header. E: Glass-button-stem header. F: Old-style seal press.

As a result of these negotiations, the RCA Radiotron Company was formed as of January 1, 1930, and GE's Harrison, N.J., Lamp Works was turned over to RCA at the same time. RCA agreed to limit its research, development, and manufacturing efforts to radio receivers and receiving tubes. GE and Westinghouse agreed to confine their efforts to radio transmitters, transmitting tubes, and the application of vacuum tubes to industrial uses.

In May, 1930, the government brought suit against RCA, claiming these agreements constituted a "restraint of trade." The suit dragged on until November 21, 1932, when the now-famous Consent Decree was handed down. The decree permitted the concerned companies, after a lapse of two-and-a-half years, to engage in competition in all fields as of May 21, 1935.

In the interim, GE had dismantled its radio-receiver and receiving-tube engineering departments at Schenectady and the personnel from these departments had sought work elsewhere. At this time J. C. Warner, B. J. Thompson and George M. Rose joined RCA at Harrison.

Preparing to resume activity, GE had to reorganize these departments. This it did as of January 1, 1933. George F. Metcalf was appointed to head the new Vacuum Tube Engineering Department. He was joined shortly thereafter by J. M. Cage and James E. Beggs in April and R. J. Bondley in November. These are the men who, together with William C. White, were responsible for the all-metal receiving tube.

In January 1933, at the first meeting of the newly formed departments, the determination was made to develop something radically novel if they were to have a marketing edge in the competitive receiver field upon their return in 1935.

During the early months of 1933, they did considerable research on the electron-beam tube and on small glass tubes for high-frequency use. In April, Metcalf built a sample receiving tube with a copper anode as part of the container, as with the water-cooled transmitting tubes of the day and the recently released British Catkin tube.

The results of these experiments convinced them that they must look elsewhere if they were to find an answer to their problems. To understand why the group had not considered the idea of an all-metal tube prior to this time, or at least why they did not pursue the idea even though GE was then very much involved with the production of an all-metal tube, we must go back several years.

The idea of an all-metal tube was not new - patents and dockets predate 1915. However, the technology was not available for practical production. From 1919 through the early Twenties the technology for making high-power glass-metal transmitting tubes was developed and perfected. Unfortunately, it had no practical application to production of an all-metal tube.

In November, 1931, White ("father of the all-metal vacuum tube") suggested to the staff members of GE's Vacuum Tube Development group that they consider developing an all-metal phanotron or thyratron tube. A short time late, H. J. Nolte was specifically directed to investigate this matter. By May 25, 1932, he had built, exhausted and tested the first all-metal tube (tin-can shell as anode, two refrigerator seals for filament-wire feed-through, a coated ribbon filament and a copper seal-off tube lined with solder).

During the next few months a number of similar tin-can tubes were completed and tested. These were followed by a series of copper-can tubes. Although many difficulties were experienced with these tubes, none were considered to be of fundamental nature.

Between January and June 1933, the GE engineers found solutions to the remaining major technical problems that had prevented them from producing a practical and economical all-metal tube. In rapid succession, thyratron-controlled welding was successfully investigated and Fernico, an alloy with the same coefficient of expansion as "AJ" glass, was developed. The "eyelet" seal for low-current tubes and the "pedestal" seal for high-current tubes were perfected. Although much work remained to be done before a practical and economical all-metal tube could be produced, the goal was in sight.

When the members of the Vacuum Tube Engineering department met in July, it was only natural, in the light of recent events, that the subject of an all-metal tube should be discussed. In August, pursuing an idea he initiated at the July meeting, Beggs completed the design of the first all-metal receiving tube. On September 7, he successfully built, exhausted, tested and demonstrated the first steel-shell model of this design. It was so well conceived that it served as a model for other types.

The designs of these early tubes, virtually unchanged, were used by RCA in production almost two years later. Beggs deserves great credit for the novel and ingenious developments which made the all-metal receiving tube a success.

Messrs. White and Metcalf were favorably impressed with the demonstration of the sample tube and agreed it was most promising. R. J. Bondley joined the group in November and was assigned the task of finding practical solutions to the manufacturing problems of the new tubes. During the next year he made many significant contributions to this new technology, by either initiating new methods or perfecting existing ones, especially in the field of welding. By January 1934 GE was firmly committed to the use of the all-metal tube in its receiver-development program.

In April 1934, GE made two apparently contradictory moves. Messrs. Metcalf, Beggs and Bondley were sent to Ohio to work under the direction of Mr. Pritchard. Their job was to ready GE's incandescent-lamp factory at Nela Park, Cleveland, for the production of metal tubes in quantity. GE then entered into negotiations with RCA to have them take over the manufacture of all-metal tubes! The first move was probably made to give them a lever in the negotiations and also to protect themselves should the negotiations fail.

In May, H. F. Mayer completed development on the pencil-rectifier tube and built several successful samples. This work lead directly to the development of the uniquely designed 5Z4 power rectifier. By July 1934, Nela Park completed the first batch of all-metal prototypes. Throughout the summer the top-secret negotiations between GE and RCA continued, known only to the upper administrative echelon in each company. The proposed permanent-component aspect of the new metal tubes must have been a stumbling block in these negotiations because GE decided in September to use terminal boards to accommodate the tube leads.

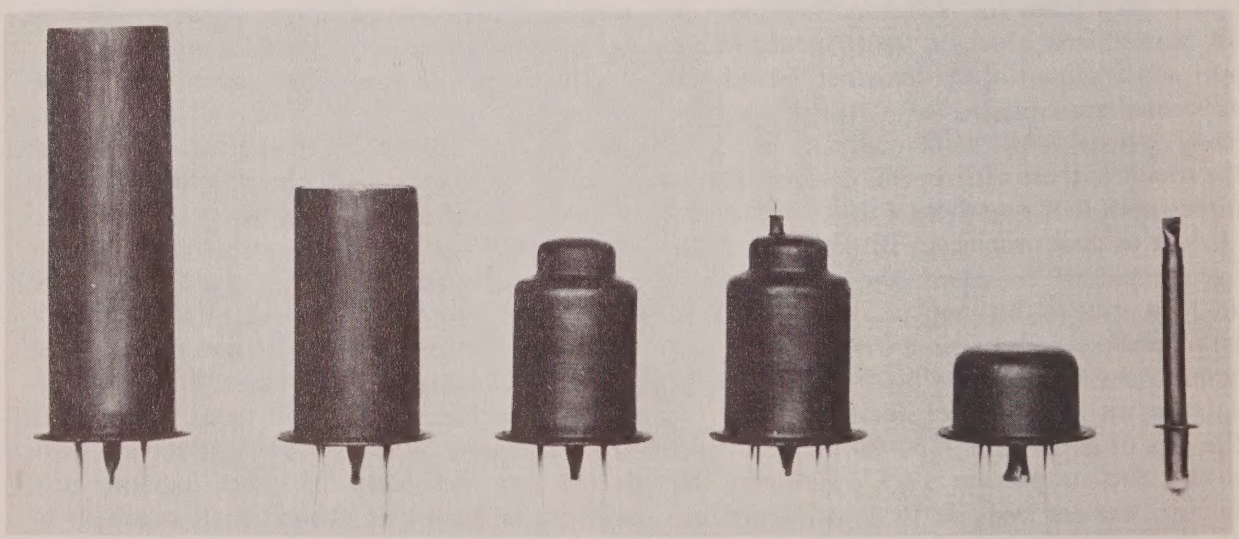
Finally, on October 9, 1934, a contract was signed between GE and RCA. RCA assumed full responsibility for manufacture of metal tubes. Two days later at their Nela Park plant, GE released plans, designs and samples of the all-metal tubes to J. C. Warner of RCA. On October 23, RCA announced its plan to base the metal tubes with their newly developed "octal" base.

Plans were made immediately to equip "Factory #1" at Harrison for the manufacture of metal tubes. A section of the factory was boarded off and all activities carried out in utmost secrecy. RCA assigned men from their Engineering Research and Production departments to this project, together with advisors from GE. By the end of November the machinery was set up and ready to operate. The first working samples were produced in early December. George "Wally" Crawford was in charge of metal-tube production. Fortunately, he kept a personal diary giving an almost daily history of the trials and successes encountered in the first production.

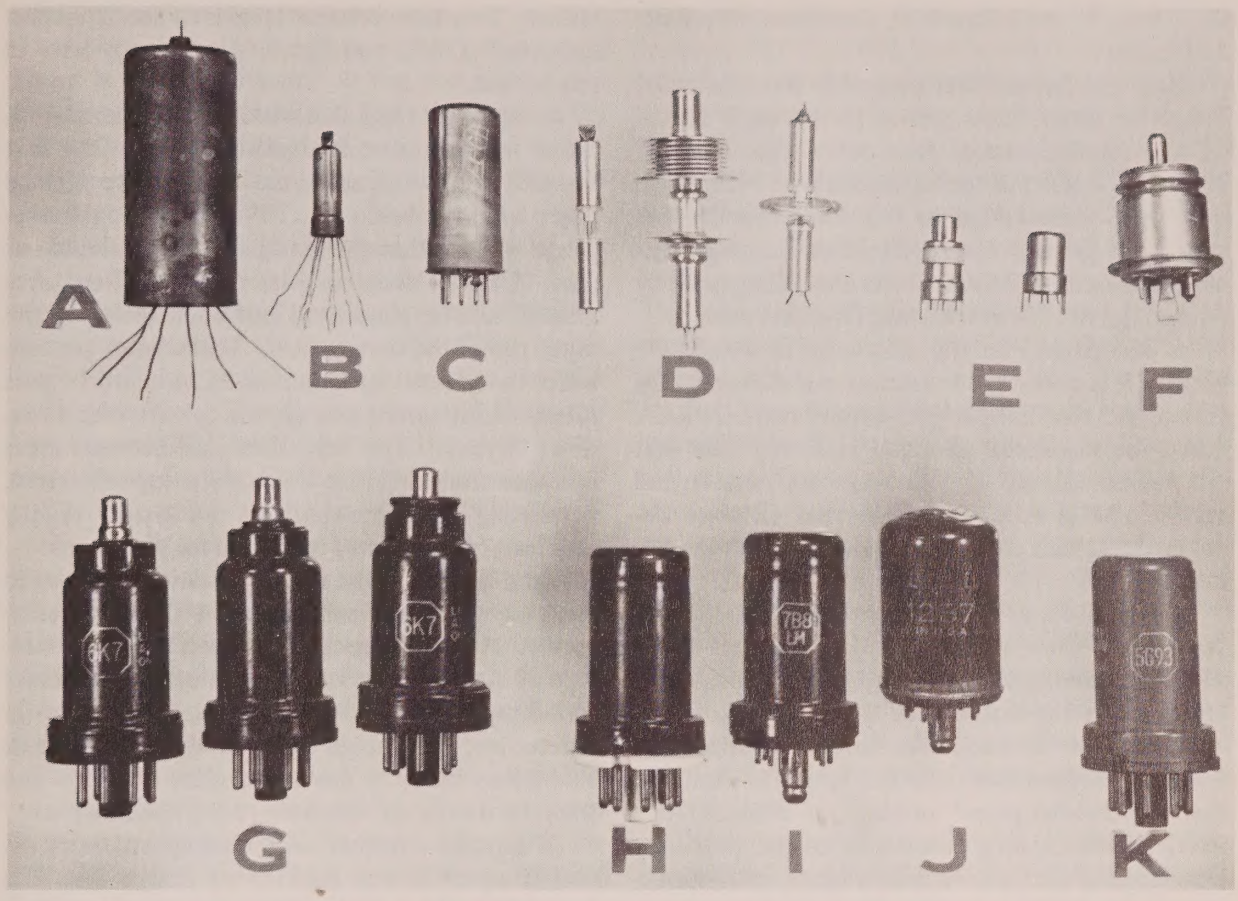
It is a tribute to the skill, patience and perseverance of these men that were able to meet their deadlines. By March 1935, they were ready to send a large number of each tube type to the GE receiver plant at Bridgeport, Conn., for testing in the new receivers scheduled for release in the Fall.

On April 1, 1935, GE and RCA unveiled their revolutionary all-metal receiving tube at the annual IRE show in New York City. Their big secret had apparently been kept well. Although the "grapevine" had leaked some vague rumors, the other tube and receiver manufacturers were totally unprepared for this bombshell. There was good reason for their panic, since by this late date they were already committed to their Fall line. The all-out publicity of the next few months was effective. By the end of June over 25 companies had joined the metal-tube bandwagon and more were to follow. This announcement of the metal tube sparked reams of coverage in the literature of the day, some of it controversial or negative.

Many of the smaller manufacturing companies could not afford to compete in the metal-tube market because of the expensive equipment required. During the course of the next year a number of them developed MG (metal-glass) tubes to solve their problems. These were tubular glass-shell tubes with close-fitting aluminum shields crimped over the base and painted black to resemble metal tubes. Although somewhat larger and different in shape, these were widely accepted as "metal" tubes. They were made by at least the following companies: Arcturus, CeCo, Champion,

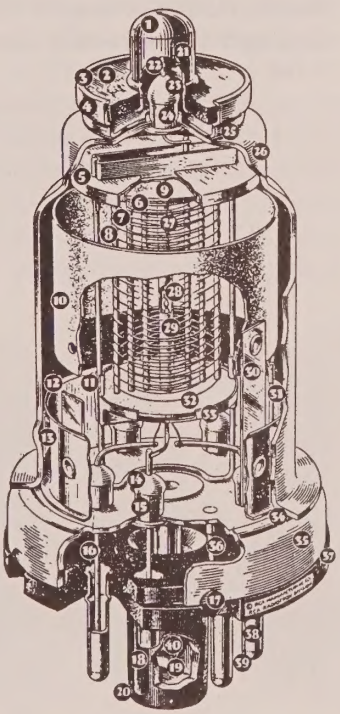


All-metal tubes produced by GE at Nela Park, Cleveland, in July, 1934, and turned over to RCA on October 9, 1934.

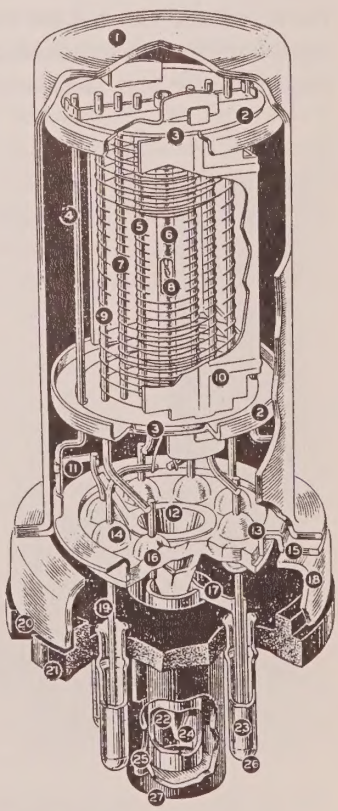


A: Early experimental metal tube (September, 1933). B and C: Developmental subminiature types. D: UHF pencil tubes. E: Nuvistors. F: Gold-plated metal lighthouse-style tube, Western Electric 416A. G: Three vintages of the 6K7. H: Developmental isolantite-base metal tube. I: Loctal-metal (LM) type. J: GE's 12B7 (low-cost LM). K: 5693 "Special Red" high-reliability computer tube.

1—SOLDER
2—CAP INSULATOR
3—ROLLED LOCK
4—CAP SUPPORT
5—GRID LEAD SHIELD
6—CONTROL GRID
7—SCREEN
8—SUPPRESSOR
9—INSULATING SPACER
10—PLATE
11—MOUNT SUPPORT
12—SUPPORT COLLAR
13—GETTER TAB
14—GLASS BEAD SEAL
15—EYELET
16—LEAD WIRE
17—CRIMPED LOCK
18—ALIGNING KEY
19—PINCHED SEAL
20—ALIGNING PLUG
21—GRID CAP
22—GRID LEAD WIRE
23—GLASS BEAD SEAL
24—EYELET
25—BRAZED WELD
26—VACUUM-TIGHT STEEL SHELL
27—CATHODE
28—HELICAL HEATER
29—CATHODE COATING
30—PLATE INSULATING SUPPORT
31—PLATE LEAD CONNECTION
32—INSULATING SPACER
33—SPACER SHIELD
34—SHELL-TO-HEADER SEAL WELD
35—HEADER
36—SHELL CONNECTION
37—OCTAL BASE
38—BASE PIN
39—SOLDER
40—EXHAUST TUBE



1 — METAL ENVELOPE
2 — SPACER SHIELD
3 — INSULATING SPACER
4 — MOUNT SUPPORT
5 — CONTROL GRID
6 — COATED CATHODE
7 — SCREEN
8 — HEATER
9 — SUPPRESSOR
10 — PLATE
11 — BATALUM GETTER
12 — CONICAL STEM SHIELD
13 — HEADER
14 — GLASS SEAL
15 — HEADER INSERT
16 — GLASS-BUTTON STEM SEAL
17 — CYLINDRICAL BASE SHIELD
18 — HEADER SKIRT
19 — LEAD WIRE
20 — CRIMPED LOCK
21 — OCTAL BASE
22 — EXHAUST TUBE
23 — BASE PIN
24 — PINCHED SEAL
25 — ALIGNING KEY
26 — SOLDER
27 — ALIGNING PLUG



The original all-metal tube (40 parts) and the S-line single-ended tube (27 parts).

Gold Seal, Hytron, Ken-Rad, Raytheon, Republic, and Triad.

After the fanfare that preceded the coming of the metal tubes, their arrival in the early fall of 1935 was anticlimactic. Nine tubes were released in the original set of tubes. By June of 1936, more new types were added to this list. Metal tubes were here to stay. Improved manufacturing techniques permitted RCA to lower the selling price by an average of 20% at the end of the first year.

As background for the next stage in metal-tube history, it is necessary to retrace our steps slightly. In late 1933 or early 1934, rumors reached RCA about the wonderful all-metal receiving tube that GE had developed. This caused some concern and set the wheels in motion for a total effort to develop a tube that could be competitive with the all-metal tube.

Early in 1933, as a prelude to this work, George Rose of the Tube Research and Development Department, having just completed the developmental work on the acorn tube with Thompson, decided to follow up on an idea he had for improving the glass vacuum tube. He felt he could eliminate the "parallel-flat-press" method of exhaust tube and lead-wire sealing in the base of the glass tube by arranging the lead-wires in a circle, with the exhaust tube at the center, and pressing the glass "button shape" at right angles to the lead-wires and exhaust tubes. This required only an eighth of an inch or so of glass to be in contact with each lead-wire in the seal, permitting the wires to be made considerably shorter. The circular arrangement of the wires also allowed for better spacing. Both of these improvements enabled the tube to be made much smaller and increased high-frequency capabilities. This later became known as the "glass-button-stem" (GBS), and figures prominently later in this article.

In April of 1933 Rose built a few samples to "show the engineers it could be done." The first samples used soft lead-wires. Shortly after this he made another batch of GBS tubes using heavy-gauge wire so that the lead-wires might double as pins. A few of these samples were exhausted after a small tubular glass shell had been sealed to the outer rim of the button-stem. These latter samples were the direct forerunners of miniature glass tubes, which would not appear for another seven or eight years! The only difference between them was that the miniature tubes were top-exhausted, permitting the "pin-ring" to be made slightly smaller. This idea was then filed for future use.

When the work was started to develop a tube to compete with GE's metal tube, the GBS was resurrected. A small tube was designed to take advantage of the new stem and was sealed with a tubular round-topped glass shell, less than an inch in diameter and two inches long. A close-fitting brass shield was made to cover the glass envelope and the tube was fitted with a six-prong bakelite base.

To capitalize further on the compactness of the "bullet tube," it was decided to design a special base. T. M. Schraeder developed the octal base with its orienting key. The final version of the "bullet tube" was fitted with a close-fitting aluminum shield crimped over the base. At the completion of this project, E. W. Ritter informed Rose that he was satisfied that the bullet tube was the answer to GE's metal tube and that it would be put into production if the need arose. At this time the rank and file were still unaware of the GE-RCA

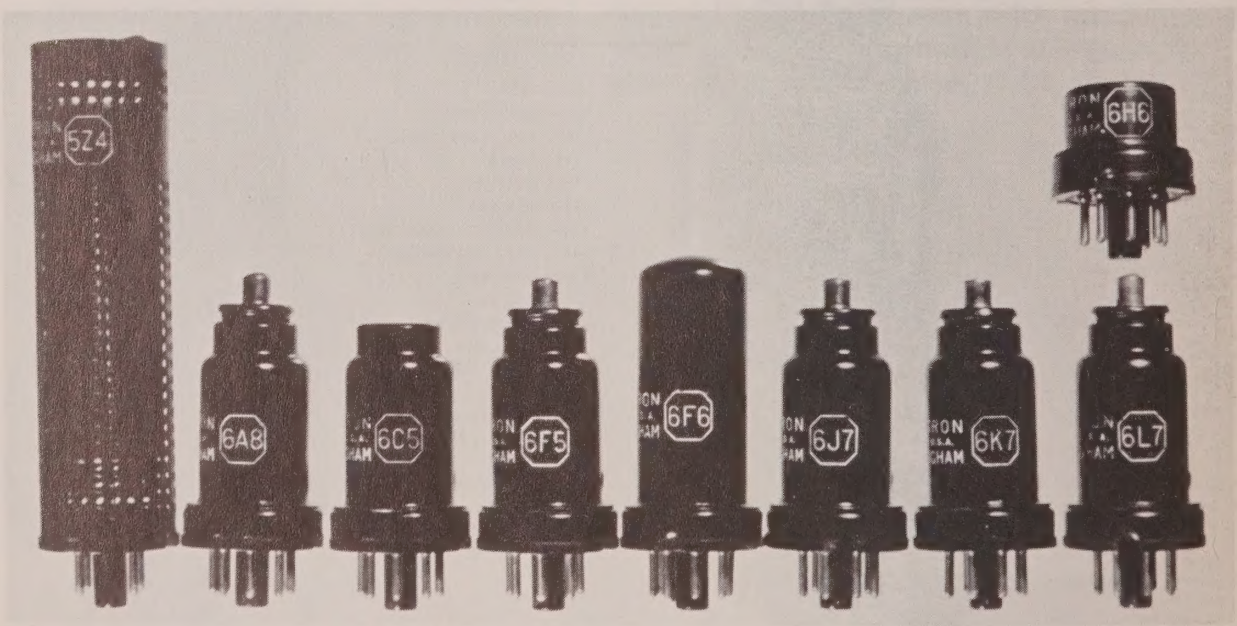


Photo No. 1. The original nine all-metal receiving tubes designed by GE and made by RCA, released in the fall of 1935. The steel-stamped labels were whitened for legibility.

negotiations relative to the metal tube.

Although the bullet tube never went into production it is most significant. It was the first of the MG (metal-glass) tubes, the first to use the GBS and the octal base. All these points played an important role in RCA's contributions to the all-metal tube.

In May 1934 Wally Crawford, unaware of the existing GE-RCA negotiations, was sent to England to study the manufacturing processes involved in the production of the Catkin tube. When he returned home in June he brought a large quantity of these tubes. The Engineering and Research Departments at Harrison made a thorough analysis of them. In July, Rose designed a special GBS and succeeded in building an RCA Catkin, considerably smaller than the British version, which could be truly called an all-metal tube. Again, apparently nothing ever came of this investigation. However, the evidence seems to indicate that the idea for the perforated metal shell used by RCA in the original 5Z4s was copied directly from the design of the Catkin tube.

In the late summer or early fall of 1935 the GBS was again recalled from obscurity. This time it was to come to the rescue of the metal tube. This recall came as a result of a cost-analysis meeting held at Harrison to examine the production expenses of the metal tube. The relatively high cost of the header (the structural base of the tube) was discussed at length. At this meeting Rose indicated that he was reasonably certain that the GBS could be adapted to the metal tube header. This would eliminate the need for the Fernico eyelets, glass beads, and copper rings then used to seal the lead-wires. He was directed to investigate this matter immediately. In February 1936, a patent was obtained for the application of the GBS to the metal-tube header. During the remainder of the year over one hundred thousand metal tubes with the new header were made and subjected to rigorous laboratory and field tests. The results were most successful and plans were made to place them in production. Warner and Ritter confided to Rose that the GBS had "saved the metal tube" by reducing the header cost from 7-½ to 2-½ cents. The first tube with the new header was released in March 1937.

The advent of the single-ended tube late in 1938 marked the last major changes in the pre-WW II metal tube. The "S" tube series enabled all the grid leads in multi-grid tubes to exit through the base. This was accomplished by special shielding and, except in special cases, eliminated the need for grid-cap tubes.

Only two conventional-type metal tubes were registered by RCA during the war and another half-dozen afterward. During the late Forties and throughout the Fifties, miniature tubes gradually replaced the metal family in new equipment. Starting in the late Fifties and into the early Seventies at an increasing rate, miniature tubes suffered the same fate at the hands of the transistor. The Compactron made its appearance in the early Sixties and, after putting up a valiant fight over a decade, it also fought a losing battle with the transistor and the latest arrival on the scene - the integrated circuit.

The rugged all-metal tube did not give up without a struggle. Shortly after WW II Rose was given the task of developing an efficient UHF tube. The metal "pencil" tube resulted from this development work. It replaced the tempermental "lighthouse" tube and enjoyed great popularity for a number of years, particularly in avionic equipment.

In the mid-Fifties, when it was evident that the transistor was making headway, Rose was assigned to develop a tube to compete with the transistor. In 1960, the last and smallest of the all-metal receiving tubes appeared. Christened the "nuvistor," it was a direct descendant of the pencil tube and was credited with saving the RCA color TV receiver. Its days were also numbered; its demise marked the end of an era in the history of radio communication.

Second generation of 5Z4 (Fall 1935) and second batch of all-metal tubes, released in the early part of 1936. These have physical characteristics of the original nine. (Labels are whitened.)

THE ALL-METAL RECEIVING TUBE - A COLLECTOR'S ITEM?

This title, if cited in collector circles, would be sure to cause some raised eyebrows, elicit quizzical looks and perhaps cast some doubt on the sanity of the speaker. Christened the "tin-tube" even before it was released, how could this unglamorous device, which was made in such vast quantities, ever become a "hot" collector's item?

Regrettably, as a result of its small stature, somber appearance, and efficient performance, the metal tube was taken for granted almost from the beginning. Its contributions to tube technology went virtually unnoted and unappreciated. In the minds of many, the look-alike construction of a multiplicity of varied tube types caused all the metal receiving tubes to be lumped into one category, with a consequent loss of their individual identities. This unfortunate, "seen-one-seen-them-all" attitude did little to help the cause of the metal tube in the eyes of the collector.

To the casual observer, all metal tubes may look alike - yet nothing could be further from the truth. In the pre-WW II metal tubes at least, a succession of visible changes took place. A study of these changes enables the initiated to date and trace stages in the fascinating development of the "new" technology of the all-metal tube.

Surprising as it might appear, the original metal tubes, as well as the "vintage" tubes of each early type, possess, to some degree, all the characteristics of the ideal collector's item. These characteristics are: (A) Antique - the original metal tubes were released over 40 years ago. This more than qualifies them as "antique" under the AWA definition. (B) Rare - although RCA produced over eighty million metal tubes prior to WW II, many of the original types and many vintage versions are in short supply and may be considered in the rare-tube class. In fact, present evidence indicates that a few of these deserve to be classified as "very rare." There are several reasons for this: (1) As metal-tube technology developed, progressive improvements were made in existing types. In most cases these improvements brought about external physical changes. As each new version of the various types appeared, production of the previous model ceased. This effectively limited the production numbers of the "vintage" versions as well as most of the later models of each tube type. During the prewar period label-styles were changed frequently, either with or independently of physical changes, and this served to limit further the availability of certain variant types. (2) The prewar production of over eighty million was divided among about 60 different types, as well as innumerable variants of most of these types. (3) These many different types were not produced in equal quantities. (4) Some of the types were superseded shortly after their release. (5) At present no evidence is available to indicate that these early models, to any great degree, were intentionally preserved. (C) Beautiful - no one, I am sure, will argue the case for the aesthetic beauty of the metal tube, yet its functional beauty cannot be denied. Unfortunately, most of its real beauty, its technical value, is hidden beneath its shell. (D) Historical significant - the all-metal tube was the first to break away from the incandescent-lamp heritage of the vacuum tube. A completely new technology had to be developed to produce the metal tube. The development of this technology ushered in the modern age of the vacuum tube and set new standards for efficiency, precision, compactness and ruggedness that were to have a profound effect on the future of the tube. (E) Personally significant - this will vary from one individual to another, but, unless very young, few can claim that, directly or indirectly, the metal tube did not play some role in their lives. (F) Easily identified and dated - it is possible to date and identify the early metal tubes simply and with reasonable accuracy by using a combination of known characteristics and label-style information. (G) Limited production - as mentioned above, the frequent changes in the early metal tubes resulted in the production of many variants of each type. This limited the production run of each "vintage" model, as well as later models of each type, to a comparatively short period after its release.

IDENTIFYING AND DATING PRE-WW II RCA METAL TUBES

Most of the listed physical characteristics and changes were obtained through the courtesy of RCA from "spec sheets" in their old files. The dates listed represent the dates on which these physical changes were authorized and not necessarily the dates of implementation.

Most of the label information was made available through the courtesy of the Newark Stamp and Die Works. Where listed, the date in parentheses to the right of the label indicates the date on which the completed label-stamp was delivered to RCA. Then, as in later years, the metal tubes were labeled before leaving the warehouse and not at the time of manufacture.

The registration dates in the Tube-Data Table are taken directly from the EIA listings and do not necessarily represent tube-release dates.

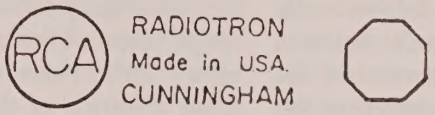
Where convenient, the types listed in the Tube-Data Table have been grouped into series. The original types in each series all have the same label-style as indicated in the Label-Style Table. This permits easy identification of the "vintage label" of each type. However, in some cases, more than one version of a particular type was made while a label style was still in effect. In these cases the physical characteristics of the tubes must be

DATING OF RCA METAL TUBES BY LABEL STYLES

(Courtesy of Newark Stamp and Die Works. Diagrams are not exact copies.)

STYLE

1



TUBE SERIES 1A AND 1B

STYLE 1: MID-1935 TO MID-1936

2A

TUBE SERIES 2 (5-19-36)

2B

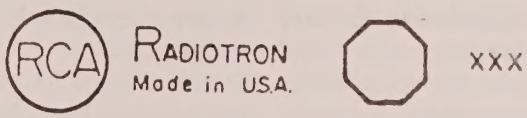
STYLES 2A AND 2B: MID-1936 TO MID-1938

3

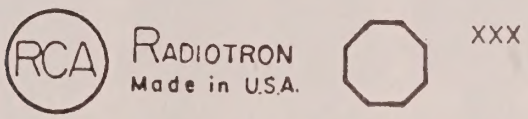
TUBE SERIES 3 (5-17-38)

STYLE 3: MID-1938 TO MID-1939

4A



4B



TUBE SERIES 4 (4-11-39)

(xxx): Date code: combinations of 2- or 3 letters or numbers.

STYLES 4A AND 4B: MID-1939 TO EARLY WW II (?)

5A

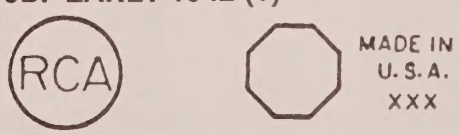
When the RCA word "Radiotron" was dropped, the logo was enlarged slightly.

5B

Probably used on home front during WW II.

STYLES 5A AND 5B: EARLY 1942 (?)

6



In use by Armed Forces by at least May 1942. JAN labels started early 1943.

STYLE 6: EARLY 1942 ON (?)

used, if possible, to identify vintage tubes.

For the convenience of the reader in following the changes listed herein, it is recommended that running reference be made to the Tube-Data Table, the Label-Style Table and the accompanying photos. "P" indicates a photographic reference.

The following facts are as accurate as presently available information permits. RCA started using date codes on metal tubes in mid-1938. No prewar dating-code information is currently available.

PHYSICAL CHARACTERISTICS OF THE ORIGINAL AND PRE-WW II METAL TUBES

A. All the Series 1A and 1B metal tubes were die-stamped, on the shell, with the "Radiotron-Cunningham" label. The "License Clause" (*LICENSED ONLY TO EXTENT INDICATED ON CARTON*) was molded in a circle on the bottom of the bakelite base just outside the pin ring.

The rubber-stamped (painted) label replaced die-stamping about mid-1936 with the release of

the 6L6. At this time the word "Cunningham" was dropped from the label and the "License Clause" wording was shortened (*LICENSED AS STATED ON CARTON*) and made part of the shell label. The "License Clause" stayed part of the shell label until mid-1938, when it returned to the bottom of the base in its original wording. The bottom of the base was blank from mid-1936 to mid-1938.

B. The shell of the original 5Z4 was much taller and wider that those of the other metal tubes and was perforated (P 1). The second-generation 5Z4 (probably early Fall of 1935) was made identical, in size and shape, to the 6F6. The label on the original version was die-stamped.

C. The shell of the original and early 6H6 was much shorter than those of the other metal tubes and had a flat top (P1). In November 1938, dome tops appeared. The 12H6 was released after this date; there was no flat-top 12H6 (P 2R & 2S).

D. The original and early 6C5 had a distinctive recessed collar at the top of the shell (P 1). This collar disappeared in March 1941. It was the last characteristic of the original metal tubes to vanish. Afterward the 6C5 was made identical in size and shape to the 6J5, etc. (P 2A).

E. In the construction of the original and early metal tubes, the header (the flat, structural base of the tube) and the base skirt (used to house, position and support the octal base) were made from a single piece of metal (top view P 2L, and bottom view P 2M). Holes were punched in the header to allow insertion of the Fernico eyelets (P 2J) with the eyelets flange on the bottom side of the header (P 2M). The eyelets and exhaust tube were then simultaneously resistance-welded to the header. Copper rings were slipped over the eyelet stems on the top side of the header and melted to insure a vacuum seal in case the eyelet-to-header weld did not take. The fused copper ring is visible between the eyelet-stem base and header (P 2L).

Early, probably in the fall of 1935, the copper-ring method of making the insurance seal was replaced by the copper-gutter method. A gutter was impressed on the bottom side of the header and a piece of copper wire was tack welded in the "key" of the gutter (see whitened gutter P 2N). In the manufacturing process, the copper wire was melted, in a hydrogen atmosphere, and guided from eyelet to eyelet and around each eyelet by means of the gutter.

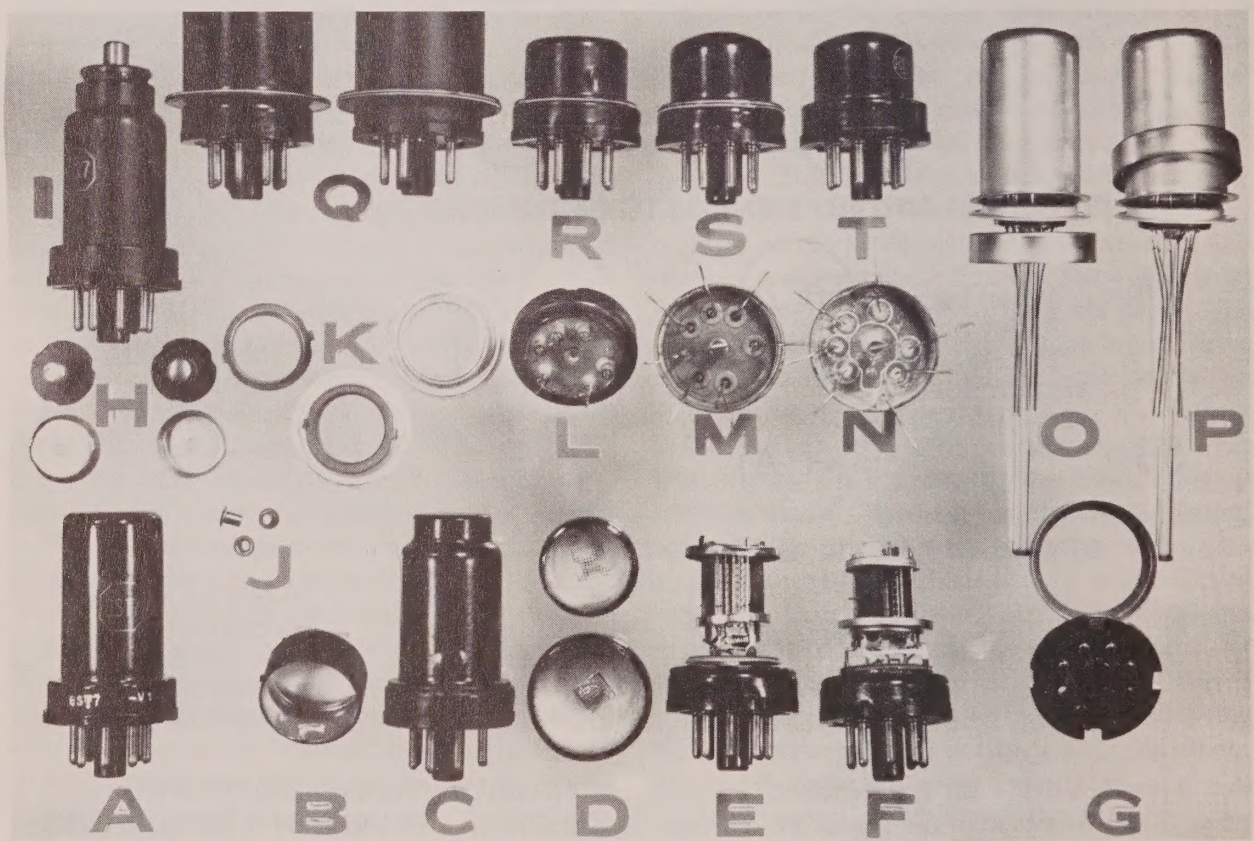


Photo No. 2. A: Die stamped base skirt. B: Getter support tab. C: Getter bump. D: Getter pellet in dome. E: Getter coil assembly. F: Getter ribbon. G: Octal base and base skirt. H: Grid-cap insulator and support wafer, top; grid cups, bottom. I: Grid-cup bump. J: Eyelets. K: Header-insert ring, right; header proper, left; welded header and gutter, center. L: Top view of original header. M: Bottom view of original header. N: Copper gutter. O: Mockup of two-ply exposed weld seam. P: Mockup of covered weld. Q: Two- and three-ply 6L6 types. R: Single-ply exposed weld seam. S: Two-ply exposed weld seam. T: Covered weld seam.

In most cases this gutter can be detected externally, thus permitting easy identification of the original and second-generation tubes. The first 5Z4 is self-dating. All the other early types, except the 6A8, have one or more unused pin-holes in the base. A wire may be used to probe for the gutter through these holes.

F. The shell connection (ground) in the original metal tubes was brought through a hole in the header and connected to a base pin for external grounding. Later, probably when the copper gutter came into use, connection was made to the shell by spot-welding a wire to the inside of the base skirt and leading it directly to a base pin (compare P 2M and 2N).

G. The original and early versions of the 6A8, 6C5, 6F5, 6H6, 6J7, 6K7, 6L7, 6Q7 and 6R7 all showed a "getter bump" about ¼ inch above the header on the shell of the tube (visible in P 2C and 2R). This bump was made to accommodate and locate the getter pellet for flame flashing, externally by torch, during the exhausting of the tube. The getter pellet was held in place internally by tack welding a metallic strip (P 2B) or wire mesh (P 2D) over the pellet.

The getter bump disappeared from the early metal tubes as the "pellet" method of gettering was gradually replaced. Starting in late 1936 or early 1937 the "getter coil" assembly began to supplant the pellet. The getter coil assembly (P 2E) consisted of a coiled tantalum wire coated with the first form of "batalum" getter -- mainly barium carbonate. The coil was surrounded by a three-sided shield open on the shell side to direct the flash and prevent contamination of tube elements by the getter vapor. The getter was fired electrically through the base pins during exhaust. This method of gettering was expensive, and about mid-1938 was replaced by the "getter ribbon." This consisted of a thin tantalum strip with a small channel or "canoe" pressed into the center portion of the ribbon. The channel was filled with the second form of batalum getter -- barium berylliate mixed with a binder. The channel doubled as a shield. The getter was flashed electrically during either exhausting or aging. In the mid-1940s the final batalum form, barium tantalate, replaced barium berylliate on the ribbon (P 2F).

By late 1938 most of the early tube types had been converted to the getter ribbon. Some were first converted to the coil and then to the ribbon; others went directly to it. The 6J5 was the first new type to be released without the getter bump, in mid-1937. All new types released after this date lacked a bump.

H. The 6F6, 6L6, and similar dome-top tubes did not have a getter bump. The getter pellet was placed in the dome of the tube and flashed externally by flame (P 2D).

In the original and pre-glass-button-stem (GBS) metal tubes with header and base skirt in one piece, the top of the header was embossed along its outer rim to accept the shell-flange weld. This resulted in an exposed "single-ply" weld-seam visible just above the header (P 2R). This is an identifying characteristic of the earlier tubes.

Starting early in 1937, as tubes were gradually equipped with the GBS, the header and base-skirt were made as separate pieces. The header was then formed of two concentric metal rings. The inner ring (header-insert ring) was made with a collar to accept the GBS (P 2K, left). This inner ring was welded to the outer silver-plated ring (header proper, P 2K, right) prior to sealing in the GBS (welded header, P 2K, center).

The outer diameter of the header was made the same as the diameter of the outer rim of the shell flange (P 2Q). These pieces were then welded. The base skirt was made with an inward flange (P 2G & 2O) and tack-welded to the bottom side of the header. This left an exposed "two-ply" weld seam just above the base skirt (P 2S & 2O). This two-ply seam indicates presence of the GBS. In some tubes, depending on the completeness of the welding job, the two-ply nature of the seam can be detected only by careful examination.

Later, probably in 1939 or 1940, some experimental single-piece headers were made. The outer header diameter of these, as well as of some two-piece headers (probably made about this time) was slightly smaller than the diameter of the outer rim of the shell flange. This resulted in an exposed single-ply weld seam. Label-style dating must be used to distinguish these from the earlier single-ply seam tubes.

I. Starting in January 1941, for economic reasons, the gauge of the metal used was reduced to about half its former thickness. This made the practice of tack-welding the base skirt to the bottom side of the header impractical. Over a period of time (no dates available) several methods were tried to solve the base-skirt problem: (a) The shell and base skirt were formed of a single piece of metal - easily detected: no exposed weld seam. (b) The diameter of the inner rim of the base skirt's inward flange was made to fit snugly over the shell and was crimped to support the octal base (P 2P) - shell and base skirt two pieces, easily detected: no exposed weld seam. (c) Same as method b except that the base skirt was welded to the top of the shell flange for better support of the octal base. Probably early in WW II, method c became standard practice.

Except for the 6F6, which made the change one year earlier (probably for field testing) and the 6L6 and similar-sized tubes which never lost their exposed weld seams, an exposed seam automatically dates the manufacture of a tube prior to Jan-

uary 1941 (exposed weld seam P 2O, R, S; covered seam P 2A, T; 6L6 P 2Q).

J. The original and early 6L6s and similar-sized tubes were taller and wider than conventional metal tubes and were made of heavier metal. The shell-flange-to-header weld was exposed and two-ply (P 2Q, left). The base skirt was made with an inward flange and was tack-welded to the bottom side of the header. Because the inward flange had a slight inward flare (due to thick metal) and the base-skirt diameter was smaller than the header diameter, a noticeable indentation ring appears between the base skirt and header (P 2Q, left).

When the GBS was applied, the base skirt could no longer be welded to the inner part of the header. The base skirt was then made with an outward flange having the same outer diameter as the header. It was then welded to the bottom of the header simultaneously with the header-to-shell weld. From this point on, the exposed weld seam became "three-ply" (P 2Q, right) and the indentation ring disappeared. This change took place on the 6L6 in June 1939. The weld seam in the 6L6 and similar-sized tubes always remained exposed.

K. The original 1851 tubes, issued early in 1938, were equipped with a top grid pin that was about half the diameter on later 1851s.

L. The original and early metal tubes with top caps used a brown wafer to insulate and support the cap. Late in 1940 black wafers began to replace the brown. By January 1941 the change was almost complete. Exceptions probably resulted from the clean-out of old stock. The black wafer was used ever after (P 2H, top).

M. In the original and early tubes with top caps the grid cup (metal cup welded to the top of the shell and crimped to support the insulating wafer) was embossed around its entire bottom circumference. Later, probably in 1944, the grid cup was only partially embossed, leaving two small unembossed bumps on opposite sides of the grid cup (P 2H, bottom). These bumps are visible between the underside of the grid cup and the top of the shell (P 2I). They were probably added to strengthen the grid-cup-to-shell weld.

N. Throughout 1938-39 a few grid-cap types were made in several different shapes. When the GBS was first applied to the metal tubes a disk was punched from the center of the header insert to allow for the insertion of the GBS. For a while RCA experimented with different ways of using these disks to form the top grid seal. Three forms of the 6K7, two of the 6S7 and two of the 6K8 have been verified.

O. Metal tubes with exposed weld seams made prior to January 1941 have been found with wartime labels. Some of these were marked "for replacement use only." Evidently RCA cleared its warehouse of old tube stocks during the wartime tube shortage for distribution on the home front.

P. Probably during 1945, the practice began of die-stamping the tube identification of the side of the base skirt. On most tubes a letter-number code, probably a date code, is also found die-stamped into the base skirt (P 2A).

Last month the "Giant" was put quietly to sleep - on April 30, 1976, the RCA receiving tube plant at Harrison ceased all production of metal, as well as glass, tubes. Even though greatly understaffed, Harrison was true to its fine tradition until the very end. Its last days were spent feverishly stockpiling tubes to meet contract commitments.

Sylvania has taken over the manufacture of the RCA "nuvistor" line. Perhaps it is most fitting that the only tube to survive Harrison, the nuvistor, is the youngest member of the all-metal tube family, the family that played a bigger role than any other in establishing RCA's reputation in the receiving-tube field.

The demise of the Harrison plant brings to a close another era in the history of communications. Although the era that lies ahead will doubtless prove technically superior to any past period, it is doubtful that it will ever match the romance of the vacuum tube. *THE VACUUM TUBE IS DEAD - LET'S PRESERVE ITS MEMORY.*

SPECIAL ACKNOWLEDGEMENT FOR HELP IN WRITING THIS ARTICLE

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- Smitty Cochrane
- Dan Pidgeon
- John Poyner
- Hoyt Warren
- Dick Watson
- The many area managers

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- Tom Briggs
- Ken Bucklin
- Wally Crawford
- George Rose
- Otto Schade
- Doc Shaw

General Electric:
- James Beggs

Newark Stamp and Die Works:
- Herb Byeff
- Alex McNab
- Gordon McNab
- Bill Stevens

Others:
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- Bruce Kelley
- Bruce Roloson
- Howie Schrader
- John Stokes
- Jerry Tyne

TUBE DATA

TUBE TYPE	REGIS. DATE	COILED GETTER	BUTTON STEM	RIBBON GETTER
Series 1A - The original nine (released early Fall 1935)				
6L7	4-29-35	4-21-37	4-21-37	5-21-38
5Z4	5-7-35	--	--	--
6F6	5-7-35	--	7-21-37	4-18-38
6F5	5-28-35	3-25-37	3-25-37	6-8-38
6A8	8-15-35	4-21-37	4-21-37	5-12-38
6C5	8-15-35	1-14-37	3-1-37	9-28-38
6H6	8-15-35	--	1-20-38	1-20-38
6J7	8-15-35	9-29-37	9-29-37	5-12-38
6K7	8-15-35	12-29-36	9-22-36	3-2-38
Series 1B - Released first half of 1936 (original characterics)				
6Q7	11-12-35	3-17-38	4-29-38	4-29-38
25A6	12-9-35	--	1-6-41	1-6-41
25Z6	12-9-35	2-3-38	1-12-39	1-12-39
6R7	1-21-36	--	11-3-38	11-3-38
6X5	2-13-36	--	7-16-41	7-16-41
6N7	--	--	7-25-38	6-27-39
Series 2 - Released mid-1936 to mid-1938 (start of paint-stamped label)				
6L6	3-24-36	--	6-25-39	6-27-39
5W4	4-1-36	--	4-30-38	--
6B8	6-15-36	3-2-37	3-2-37	11-18-38
25L6	11-4-36	12-21-36	5-11-38	5-11-38
5T4	2-4-37	--	6-6-41	6-6-41
6J5	6-24-37	3-26-37	3-26-37	12-15-38
6V6	1-3-38	7-27-37	7-27-37	2-2-40
6K8	1-31-38	--	12-2-37	12-2-37
6S7	2-23-38	--	1-20-38	1-20-38
1851	--	(orig.)	11-23-38	4-5-38
Series 3 - First "single-ended" tubes (released late 1938 to mid-1939)				
6SF5	10-7-38	--	12-16-38	12-16-38
6SJ7	10-7-38	--	8-31-38	8-31-38
6SK7	10-7-38	--	8-31-38	8-31-38
6SQ7	10-7-38	--	7-1-38	7-1-38
1852	3-18-39	--	11-4-38	11-4-38
1853	3-18-39	--	10-4-38	10-21-38
6SA7	11-18-38	--	2-24-39	2-24-39
6SC7	11-18-38	--	3-31-39	3-31-39
12SA7	2-2-39	--	3-31-39	3-31-39
12SC7	2-2-39	--	3-31-39	3-31-39
12SJ7	2-2-39	--	1-9-39	1-9-39
12SK7	2-2-39	--	3-31-39	3-31-39
12SQ7	2-2-39	--	3-31-39	3-31-39
12C8	2-2-39	--	12-30-38	12-30-38
6AC7/ 1852	3-18-39	--	10-26-38	10-26-38
6AB7/ 1853	3-18-39	--	3-9-39	3-9-39
6AG7	5-24-39	--	3-1-40	3-1-40

TUBE TYPE	REGIS. DATE	TUBE TYPE	REGIS. DATE
Series 4 - Released mid-1939 to end of 1941 (last types prior to WW II).			
12SF5	9-21-39	6ST7	12-1-41
12K8	10-16-39	6AJ6	1-25-44
12A6	10-16-39	6AK7	2-8-44
12SR7	10-16-39	12SY7	9-25-45
6SR7	4-10-40*	6SZ7	11-20-45
6SG7	2-17-41	6SB7Y	1-10-46
12SG7	2-17-41	6SV7	6-20-46
6SF7	3-3-41	12SW7	6-20-46
12SF7	3-3-41	12SY7	6-20-46
6SS7	4-22-41	12J5	4-6-50
12H6	5-5-41	5693+	4-30-48
6D5	5-6-41	5961	7-18-50
6SH7	8-1-41	6134	5-22-53
12SH7	8-15-41		

* Weld seam gone 1-1-41

\+ "Special Red"

Suffix (Y): Micanol base (spec. ground)

Suffix (X): Ceramic base (spec. ground)

OTHER MAKERS' TUBES

TUBE TYPE	REGIS. DATE
GE 6137	2-18-52
Ken-Rad 6N6	7-9-36
Ken-Rad 25Z4	12-12-38
Hytron 25A7	6-23-36
Hygrade 12A4	8-18-50
Raytheon 0Z4	10-24-35
Raytheon 0Y4	9-20-45

"LM" LOCTAL METAL TUBES

TUBE TYPE	REGIS. DATE
RCA 7A7-LM	9-21-39
RCA 7B6-LM	3-13-40
RCA 7B8-LM	3-13-40
GE (Blue) 12B7-LM	6-6-39

"1600" METAL-TUBE SERIES

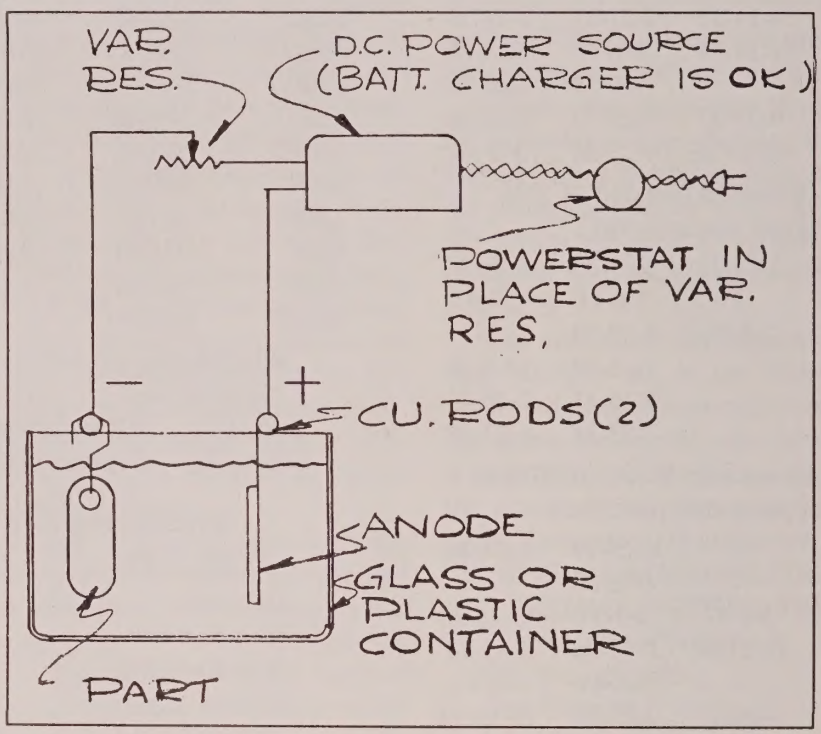
1611	6F6 selected for cutoff
1612	6L7, low microphonic noise
1613	6F6 selected for trans. ratings
1614	6L6 selected for trans. ratings
1619	6L6, 2.5-V quick-heating fil., 9-24-43
1620	6J7, low microphonic noise
1621	6F6 selected for long life
1622	6L6 selected for long life
1631	6L6, 12.6-V heater version
1632	25L6, 12.6-V heater version
1634	12SC7 with matched triode sections
1649	6AC7, low microphonic noise
1655	6SC7 with matched triode sections
1664	Special 12C8

PLATING PARTS WITH NICKEL, COPPER, CADMIUM, OR SILVER

Vern Peterson

Vol. 17, No. 2, Sept. 1976

Buff the part to be plated to a high luster (the sheen of the plating depends on this finish). Clean the part in a caustic solution or commercial preparation called an activator, rinse, and wipe dry. Suspend the part in plating solution (catalyte) and connect to the negative terminal of the DC power source. Suspend the anode in the solution and connect it to the positive terminal. The power supply may be any rectified source with some means of controlling voltage, such as a rheostat or Powerstat, with a maximum output of 12 volts. Some experimenting may be necessary to obtain correct voltage. The solution should be warm. Too high a current (voltage) may result in uneven buildup.



The amperage drawn depends on the size of the part being plated, but for small radio parts 4 amps is usually enough. Adjust voltage until bubbles form on the part and then back off until they stop. (An ammeter may be placed in series with one of the leads as an indicator.) Agitate the solution or part slightly during the plating cycle. When the part is plated, rinse and wipe dry. Slight buffing may be desired.

Parts too large for the plating tank may be plated with an anode covered with a porous insulated sleeve connected to the positive, with the negative connected to the part. The anode is moved over the part by hand. This is available as a commercial item called an "Applicator."

A possible source for materials and approximate *[1976]* prices: Nickel-plating solution: $5.75/pint; anodes: $5.25; applicator - hand plating: $10.50. Supplies available from: Rapid Electroplating Process, Inc., 1414 S. Wabash Ave., Chicago, IL 60605.

SOME NOTES ON NICKEL PLATING

Art Goodnow, W1DM

Vol. 17, No. 2, Sept. 1976

Some years ago I assembled a facility for in-house plating of new and replica parts, as well as the re-plating of antique items. Nickel can be deposited directly on copper, brass and similar alloys without use of highly toxic chemicals.

Anodes. After a fruitless search of hobby houses and local plating firms, a one-pound lot of pure nickel strip one-inch wide and 1/8-inch thick was obtained from the Fisher Scientific Co. (52 Fadem Rd., Springfield, NJ 07081). Unfortunately, the strip is supplied chopped in pieces an inch and somewhat upwards in length. To cope with this problem, the successful "chain-mail" anode structure in the picture was devised. Several of the longer chunks were sawed into strips of square section and rings formed of these were used to link the remaining sections together. The uppermost segment is bent into a hook to engage the supporting rod.

Tank. Any glass or plastic container of suitable size can be used. A two-quart jar is adequate for most work.

Electrolyte. The bath selected has the following ingredients: nickel(ous) sulphate, $NiSO_4 \cdot 6H_2O$, 8 oz.; ammonium chloride, NH_4CL, 1 oz.; boric acid, H_3BO_3, 1 oz.; water to make 2 quarts.

A postal scale may be used for weighing; precision is not required. These chemicals are also available in one-pound lots from Fisher and other laboratory supply houses.

Preparation of Work. The piece to be plated should be sanded clean and free of pits and scratches. A finish sanding with 240-grit paper leaves a surface yielding a pleasing matte on plating, which alternatively may be buffed to a high polish with rouge buffing compound. Remove all traces of oily contamination immediately before plating. Although a caustic dip is used commercially, a thorough hand scrubbing with a wet rag and scouring powder gives a good uniform job. On the final rinse, make sure that the pieces wet uniformly with no trace of a "water break."

Plating. Two anodes are hung at the edges of the tank from a brass-rod bus structure which connects to the DC supply. The work pieces are suspended, midway between the anodes, on hooks made of small copper wire from the negative bus. The most consistent results have been obtained with a current of 60 mA per square inch of exposed work area. A plating period of 60 to 90 minutes yields a thickness approaching one mil which is considered heavy plate. Since the drop across the plating cell is about 2 volts, a low-voltage rectifier or a storage battery in series with a rheostat is a convenient source of current.

Finish. Rinse in hot water and dry with a clean rag. Buff if a polished surface is desired.

Reference: Blum & Hogaboom, Principles of Electroplating and Electroforming," 3rd Ed., McGraw-Hill, 1947.

Art Goodnow's plating layout: jar, meter, and rheostat. In the foreground, a freshly replated socket and a "chain mail" anode.

REFINISHING ATWATER KENT METAL PARTS

Ross Smith

Vol. 11, No. 4, March 1971

If you have a good eye for matching colors, the gray-green and brown AK colors for early board-set parts and later-model front panels can be duplicated easily using small cans of enamel from your local hardware or paint store. Some differences in color and consistency of different brands of paint must be considered, so it will be necessary to "trim" the final mix to match the original color. For a start, use the mixes suggested below and try for color on a metal surface. Trim by adding very small portions of the color needed, mix and try the color again. With a bit of time and patience, you will obtain a perfect match.

For AK brown, mix two parts of chocolate brown with one part black by volume. For AK gray-green, mix four parts olive green with three parts of black and two parts white. It is a good idea to use the same brand of paint for each color for compatibility. This the mix as required for spraying. Spray a light primer coat, dry and finish with a final coat.

If the original is crackle or wrinkle, the new paint in thin coats will duplicate very well. If refinishing from the base metal is required, use a prime coat of crinkle paint, such as GC-Walsco #146-12 Gray Wrinkle Finish. This is an air-dry paint, but a little added heat from a heat lamp will give it a finer crackle texture that will look almost identical to the original.

If the finish is too bright or glossy when dry, spray a light coat of dull lacquer such as Testor's Clear Dullcote No. 1260 over the enamel finish. Be sure the enamel is dry and hard because lacquer will lift soft enamel. Testor's Dullcote is available at hobby and variety stores.

Be very careful when masking nameplates. If you cannot take them off, protect them with a coat of clear acrylic or clear enamel. When dry, mask them with tape that has been used several times to reduce its holding power. You certainly do not want to pull off those beautiful letters and colors when you remove the tape!

W2HDR

Vol. 12, No. 1, June 1971

More on AK paint - most vacuum-cleaner supply houses have a spray paint, plain and crackle (usually for Hoover) that nearly matches the Atwater Kent colors.

REPAIRING AERIOLA SENIOR GRID LEAKS

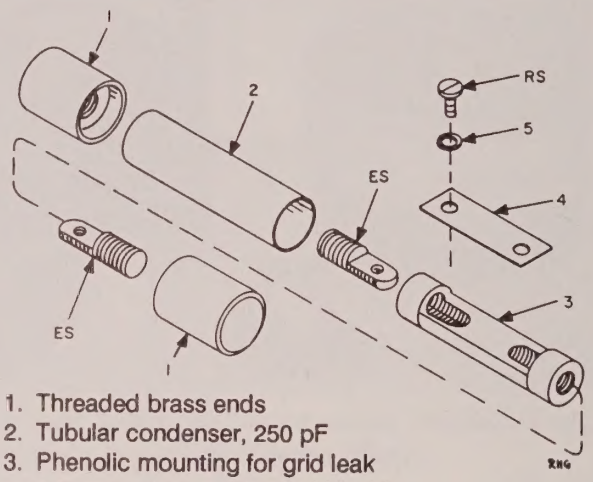
L. W. Elias, W4DBT

Vol. 12, No. 4, March 1972

In the restoration of an Aeriola Senior, it is frequently found that the grid-leak/condenser combination (looks like a 30-amp cartridge fuse) is defective.

A simple remedy is to solder an outboard resistor and condenser across the fuse clips and remove the grid-leak/condenser. For the purist this is not the answer. Bear with me a minute and we will see the answer.

As can be seen from the sketch, this gadget is really an ingenious bit of circuitry. Radio manufacturers would go out of business (and some out of their minds) nowadays making a simple RC network this way.



1. Threaded brass ends
2. Tubular condenser, 250 pF
3. Phenolic mounting for grid leak
4. 2-5 meg. card-resistor "grid leak"
5. Washer

ES End screws
RS Resistor-card screws

Back to the sketch - the condenser (2) is actually built into the wall of the tube. Its plates extend one at each end. Such a condenser with plate ends exposed is known as an extended-foil type. Lead rings on each end connect to the plates and in turn press against the threaded brass ends (1) to make electrical connection. Usually old age has caught up with these connections and they must be scraped shiny. This is done by scraping the wax away from condenser ends where they enter the brass. Once this is done, you can unscrew the brass ends and clean the lead. Do all this carefully: this gadget is delicate. If cleaning doesn't do the trick, you can easily connect a 250-pF mica condenser to the two screws (RS) before reassembly.

It is possible that the grid leak (4) is open. Its resistance is not critical. A good one measures 2 to 5 megs. If the resistor is open, a 1/4- or 1/8-watt 10% composition resistor also connected to screws (RS) will suffice. With these repairs as an "inside job," no one will ever know but what the gadget was good all along.

One note of caution. This unit was originally more or less wax-impregnated after assembly to keep out moisture. It is advisable that you put some wax (beeswax or candle wax, but not sealing wax) around the ends of the condenser where they go into the brass. Do this after reassembly. Chances are it will work okay for another 40-50 years.

An antique radio collector friend of mine, Al Perkins, told me about repairing this condenser. I thought it was good enough to share with AWA members.

REPAIRING ATWATER KENT DRIVE BELTS

Roland Matson

Vol.10, No. 2, Sept. 1971

When the belt is missing on the gang condenser drive, copper Dymo tape makes an excellent substitute. Merely cut to length and solder.

W3LST

Vol. 20, No. 4, March 1980

If the band belt on your AK 20 is broken, a quick and easy method to solve the problem is to solder a small phosphor bronze wire to the pins. The wire is pliable and will do the trick until a replacement band is found.

Paul Bohlander, W3VVS

Vol. 23, No. 4, March 1983

Damaged drive belts may be repaired in the following manner:

- Clean the broken ends of the belt.
- Lightly tin the area near ends of the belt 1/8-inch beyond the drive-pin holes.
- Butt the ends of the belt together and place on a flat surface.
- Cut two ½-inch long pieces of "Soder-Wick" and place in position on the surface of the belt to bridge the break on each side of the drive-pin hole.
- Touch and press a soldering iron at each end of the "Soder-Wick" to form a soldered joint with the belt surface.
- Shape the soldered joint to the approximate contour of the pulley surface; enlarge the drive-pin hole to accept the drive-pin, if necessary.
- Assemble the drive belt to the pulleys and set the tension so as not to overflex the repaired joint.

REPLACING TRIODE TUBES WITH FIELD-EFFECT TRANSISTORS

TRANSISTOR SUBSTITUTE

Vol. 7, No. 4, Winter 1966

Serge Krauss has on several occasions substituted a transistor (FET) for a tube in old receivers. The transistor appears to perform just a little better but the regeneration control isn't as smooth.

SOLID-STATE TUBE REPLACEMENT IN EARLY RECEIVERS

Fred Rice, WA3KID

Vol. 16, No. 1, June 1975

Ed. note: Collectors of early receivers, like antique car buffs, insist on original components and frown on substitutes or changes in design. This makes it difficult (and expensive) to operate certain early broadcast receivers which use expensive tubes such as WD-11s. Fred Rice solved the problem by using low-voltage solid-state substitutes. AWA members attending the 1974 Conference witnessed Fred's demonstration of a Radiola III with balanced amplifier operating a loudspeaker powered only by a small 6-volt battery.

Having read Bob Morris' article in the June 1974 OTB telling of using transistors in an AK breadboard, I decided to try and do the same in other early receivers, but without changing the wiring.

I also wanted to simplify the problem of handling delicate MOSFETs. The answer was the use of an inexpensive N-channel J-FET such as HEP 801 which works nicely and was found easy to handle.

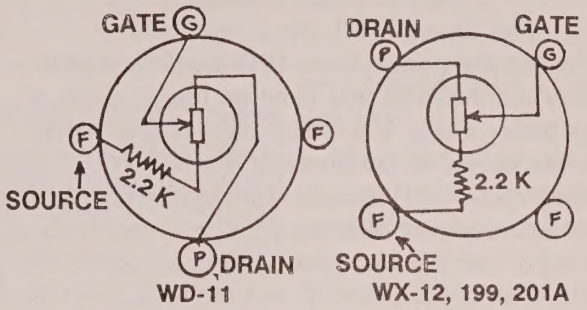
The first receiver to be transistorized was a Radiola III which I had purchased at a recent ham-fest for eight bucks. This was an ideal choice since they are quite popular and use the hard-to-find WD-11 tubes.

My objective was to make plug-in units to *replace* each tube and *not* change the wiring. Obtaining several defunct WD-11s (which was not hard since nine out of ten have open filaments), I removed the glass envelope and rewired the empty tube base as shown in the diagram.

A 2200-Ω resistor was found to be an ideal source resistor (equivalent to a cathode resistor). This eliminated the need for any fancy bias circuit for the J-FETs. Neither was a bypass capacitor necessary, since the circuit already had too much gain and added capacity could make it unstable.

Operation. Plug in the rewired tube bases, tie all the B+ leads together and fasten to the plus (+) of a six-volt battery. Short all the remaining leads (A+, A-, C-, B-) and fasten to the negative (-) battery terminal and you're in business!

Other Receivers. The same procedure was tried on an Aeriola Senior belonging to Ron McClellan. The set worked beautifully. There is one drawback, however, to these J-FETs: they won't handle much power, so don't expect to drive a loudspeaker unless you have an amplifier such as the balanced audio amplifier with the Radiola III.



I have also tried the solid-state replacement units in a Radiola 25. Here I had to make a slight change: there was a need to pad the second IF "tube" with a 1000-pF capacitor from "P" to "F" pins to prevent oscillation. Rotating the loop acted as a perfect volume control! Using this set in Philadelphia, I was able to receive CHML in Ontario and numerous other stations with loudspeaker volume.

A TRICK

Vol. 16 No. 2, Sept. 1975

Jerry Beaudin pulled a clever trick on us while attending the recent IHRS/AWA Purdue Meet. He removed the glass envelopes from several UX-201A tube bases and inserted solid-state components per Fred Rice's article. He then re-inserted the glass envelopes - and there was a receiver working with unlighted filaments!

TRANSISTORIZING THE RADIOLA III

Ed Culver, WA2JAA

Vol. 22, No. 4, March 1982

Bud Bedker gave the Museum two WD-11s that he had transistorized and I volunteered to get a Radiola III operating for demonstration. Naturally, the AFT had an open winding, so I inserted one of Fred Hammond's custom-made replacements. The other part that nearly always needs replacement is the rubber tube-socket cushion. I cut the proper size from an old heavy tire tube.

I have restored several IIIs and find they vary slightly. This one had a coil spring connection for the two rotors - others don't. I inserted the WD-11s (with FETs), connected the two B+ leads to +3 volts and all the other wires to minus.

The set seemed to work except I could hear a kind of grid hum. Checking the circuit, I found, for some reason, there was no grid-leak. Rider's Manual shows a grid leak but this set and the one I have do not. How come? The hum cleared up when I placed a half-meg resistor across the grid condenser. Stations were plentiful, even with a short antenna. The rheostat appeared to have no effect on the volume. Hand capacity was quite noticeable.

THE RCA 825 INDUCTIVE-OUTPUT AMPLIFIER (THE HAEFF TUBE)

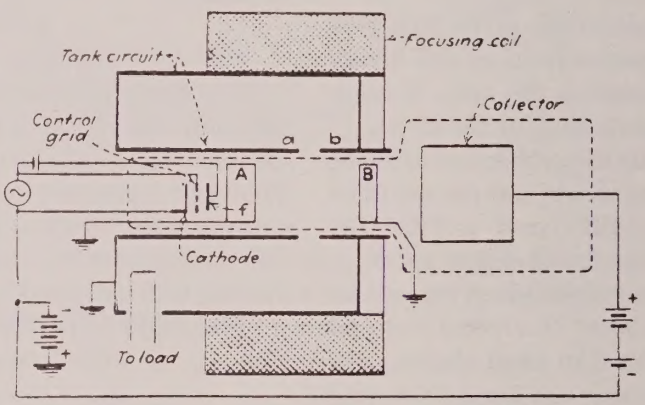
Part 1 - Bruce Roloson

Fact Sheet, Vol. 3, No. 2, April 1978

During the period from 1937 to 1942, a great deal of development was done on transmission of frequencies above 300 MHz. This development was accelerated by the events of World War II.

Many early UHF electron-discharge devices had such inherent problems as electron transit time, loading of internal parts, power dissipation, and interelectrode capacitance. It was not until an RCA research pioneer, Andrew V. Haeff, developed his inductive-coupled-output amplifier that these problems were overcome. Haeff did most of his work on the amplifier from late 1938 to late 1939. It went on the market early in 1940 as the 825, rated for 35-watt output at 300 MHz.

The 825 was 8-3/4" long, with maximum diameter of 2-1/16". It had three basic areas in its operation. At the small end was the electron-gun assembly, containing the cathode, control grid, focusing electrode, and accelerating electrode A. At the large end was the collector section; made up of accelerating electrode B, suppression grid, and collector. The electron-gun and collector parts of the 825 supplied a focused stream of electrons. The third main area was the neck of the tube between the accelerator grids A and B. This part of the 825 is where the external tank-circuit chamber, output loop, and magnetic focusing coil were placed. For its time, this idea of the interior operation of a vacuum tube being inductively coupled to the output was unique. A later development of the 825 placed the tuned chamber inside the envelope. The reason for moving the tuned chamber inside was to prevent high voltage stress on the glass near the tuned chamber and resulting puncture.



The Haeff tube is important historically because it was one of the first to use the principle of inductive-coupled output, leading the way for tubes such as the klystron which soon replaced it.

I was unable to find any piece of commercial equipment that used the 825. It was basically an experimental device, replaced so soon after development that very few remain today.

Part 2 - Robert M. Morris, W2LV

Fact Sheet, Vol. 3, No. 3, August 1978

The February-March 1978 issue of the *RCA Engineer* contains a collection of papers giving the history, recent development, and some current applications of radar. One paper covering early UHF development at RCA is by Dr. Irving Wolff of Princeton. I called him on the chance that he might have used the 825 in his work and might be able to supply additional information on this rare tube. He was familiar with it but said he had not used it to any extent in his early UHF tests, since he found he could get better results with a UHF triode (probably the 1628). He referred me to Leon Nergaard, retired from RCA and living in Princeton, who worked with Andrew Haeff at Harrison in the development of the 825.

Dr. Nergaard said the inductive-output amplifier was developed at essentially the same time as the Varian brothers were working on the klystron. He said the group at Harrison first hear of the Varians' work on the "rumbatron" when tests were in progress on the inductive-output tube.

He said the short commercial life of the 825 had to do with characteristics of design which limited its application. The resonant output cavity was entirely outside the glass walls of the tube, which was advantageous in some respects but proved to be a problem in others. The flow of electrons inside the glass neck past the opening of the cavity caused charges to form on the glass which made operation with high modulating frequencies or pulse modulation quite unsatisfactory. Tests were also made by Nils Lindenblad using the 825 with a helical coil around the neck of the tube, thus obtaining amplification in the mode later known as the traveling-wave principle. This may well have been the first traveling-wave tube.

With the advent of WW II it was necessary to concentrate tube development on those things promising quick results for the least time and effort. The klystron, the UHF triode (the lighthouse tube) and the magnetron suitable for VHF, UHF and radar applications were the result. The 825 design was very rapidly made obsolete by progress. It did, however, contribute significantly to the advancement of the electronic art.

[Collector John Walker points out that the RCA 825 was distinct from the Taylor 825, a conventional power triode. Haeff published an article on his device in *Electronics*, Feb. 1939 . - Ed.]

THE PICKARD "GOLDEN AUDION"

Leo Gibbs, W8BHT

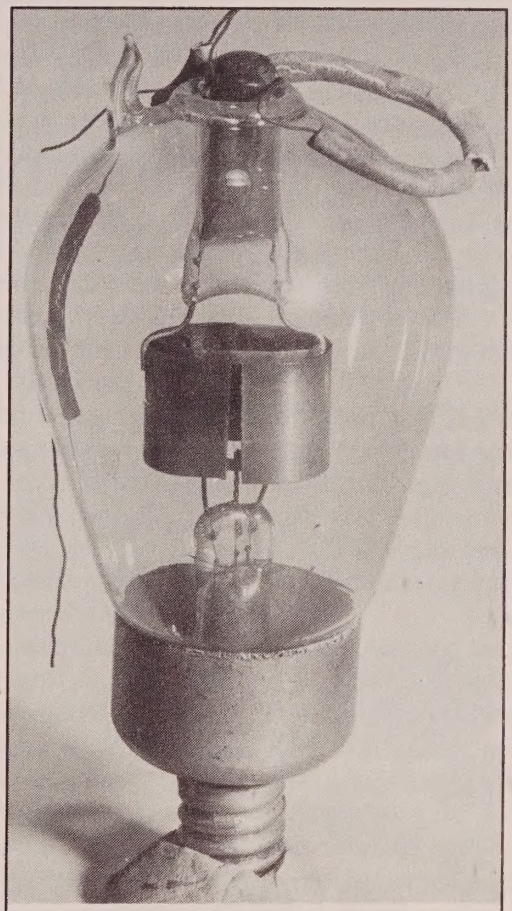
(*Fact Sheet*, Vol. 3, No. 3, Aug. 1978)

The following story is of great interest as very little is known about this rare tube. To my knowledge only three samples have survived. [LAP]

The WSA Co. Audion was developed by Dr. Greenleaf W. Pickard, chief engineer of the Wireless Specialty Apparatus Co. in Boston. It was to be an improved equivalent of the de Forest spherical audion.

In 1917 approximately 100 of these tubes were made and submitted to the Philadelphia Navy Yard in the Third Naval District on a contract bid. Several were delivered to the wireless station NAI at the Navy Yard for test and evaluation. The contract did not materialize and most of the tubes were lost, broken or stolen.

The WSA Audion was gold in color with a pear-shaped envelope, about the size of a 10-watt lamp, with the plate and grid leads emerging from the top. The filament leads were connected to a candelabra base.



Peckham collection.

The grid was an oval strip of metal with several holes punched out to permit the electron stream to pass through. The plate was also a strip of metal, oval in shape and almost completely enclosing the grid. Two filaments were available; when one burned out, the other could be used.

The Audion screwed into a candelabra socket mounted on the front of a panel or box, and grid and plate leads were connected to binding posts below the Audion. A porcelain rheostat adjusted the filament to about four volts.

This tube was a bit "cranky" in operation, but it did bring in signals quite well in the evening hours.

Credit is given to the late Ed Raser, W2ZI, and Frank Atlee, K4PI, for much of the above information.

(Continued from p. 18)

separate audio channels - one from 30 to 125 cycles into an 18-inch bass speaker, a middle-range, 100 to 6000 cycles into two 12-inch speakers, and one for high frequencies from 3000 to 16,000 cycles into two high-frequency speakers. Large separate consoles were required, one for the amplifier chasses and automatic record changer, the other for the five speakers. The weight of the unit was 615 pounds!

In mid-1937, the company announced the new 30-tube Philharmonic, one of his finest sets. It had six bands from 3.75 to 2000 meters (150 kHz - 80 MHz), 40 to 60 watts of Class A power output from push-pull-parallel 6L6s, continuously variable selectivity from 2 to 16 kc, a record-scratch suppressor, volume expansion, etc. Tuner chassis weight, 60 pounds; power supply and amp, 35 pounds; 15" woofer speaker, 30 pounds. Some of the later sets (1939) had "The Stradivarius of Radio" on the dial with a picture of a violin.

1940 was the year for the new 33-tube Philharmonic with a lot of new features like frequency modulation. There were several other models about this time, such as the Scott Super XII, Scott 16 and 18, Laureate, Phantom, Phantom De Luxe, and the Masterpiece which he brought out after purchasing McMurdo Silver. October (approximately) was the release date for the Scott Communication Receiver.

During the war he produced the Scott Marine Model (low-radiation) receiver for use on ships of the U. S. Navy and merchant marine.

After the war, the company made several models, such as the 16A and the famous 800B. It also made some TV sets. All the postwar sets carried the nameplate "Built by Scott Radio Laboratories Inc.," no longer "E. H. Scott Radio Laboratories." These same plates (with serial number) stated: "Custom Built by E. H. Scott Radio Lab." and "The Finest Are Always Hand Made."

VACUUM-TUBE PHOTOGRAPHY

Alan Douglas

Fact Sheet, Vol. 2 No. 2, April 1977

Tubes are tricky little devils to photograph, as you know if you've tried. For those who wonder how it's done, here is my process. I don't pretend to be an expert in photography: I learned out of necessity.

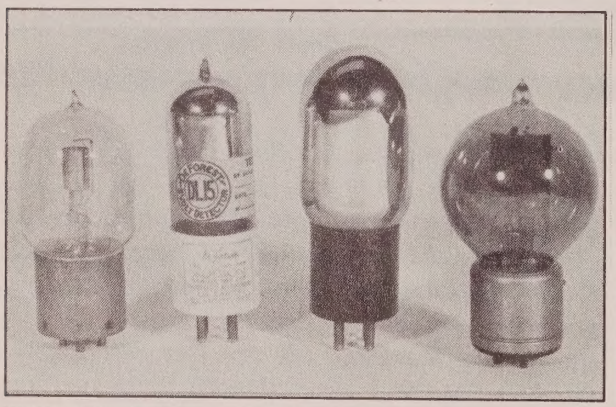
For ordinary work, like the tube photos, I use a 35-mm SLR and Plus-X film. These groups of four tubes almost filled the 35-mm negative; when I backed off so they were half as large, the enlargements showed considerable grain. I understand that Panatomic-X film is less grainy, but for any more critical work I borrow a 4 X 5 view camera with a 120 roll-film back, and I never run into grain problems with 120 Plus-X.

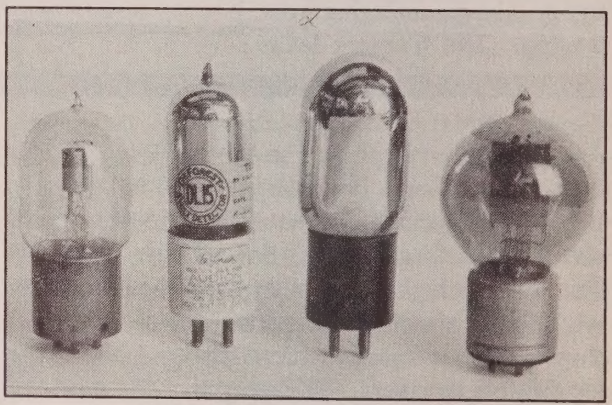
I do my own developing and printing, using the darkroom at the company where I work, so I can't offer any advice on doing it at home. But if you want decent prints, you have to either do them yourself, or inveigle a good friend into doing them properly. You'll never get what you want from the corner drugstore.

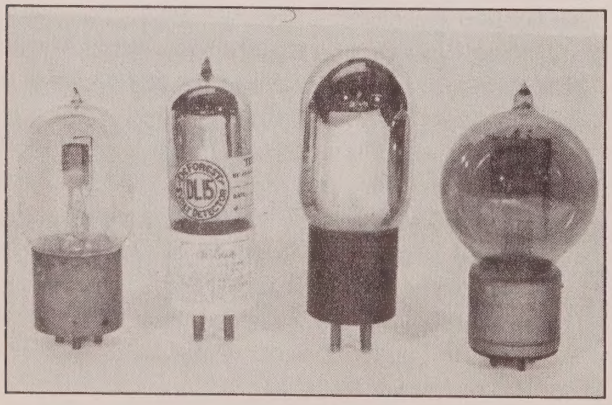
The photos show four different types of lighting. I have included four tubes to illustrate most of the different bulbs and bases you will find. The gettered bulbs are particularly hard to photograph, since they reflect everything 180° in front of them. The upper left shows the usual setup, on a white paper background, with two 500-watt quartz-iodine floodlamps. Larger-diameter lamps would throw softer shadows, but would also appear larger in the reflections from the bulbs. In the upper right photo, I used an artificial "window" made of a square of bedsheet illuminated from behind with the two lamps. The square reflection may not be as objectionable as the two round spots in the first photo, and the shadows are less noticeable. A real window works just as well.

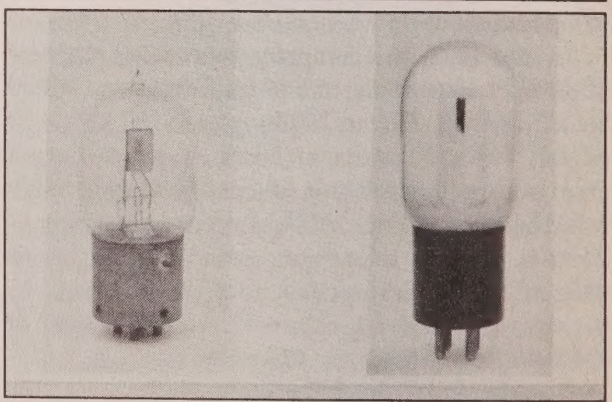
The lower left photo was made with polarized light: each lamp (the same ones) had a sheet of polarizing material in front, with a polarizing filter over the camera lens. Proper alignment of the various filters nearly eliminates the lamp reflections, though you can still see reflections of everything in the room. A room with white walls and ceiling would be far better. Notice that, in comparison with the photo directly above, all metallic surfaces are darker.

The last two photos were taken in a "tent." This is, in general, an enclosure with perfectly white walls, completely surrounding the subject, illuminated evenly from outside. In this case, it is a corrugated cardboard carton, lined with bedsheets about an inch from the outer wall, with many small lamps scattered outside the sheet, between it and the carton, to provide fairly even lighting. The major flaw in this setup is the inevitable black hole where the camera lens peeks into the tent. This can be dodged out during printing for an especially critical picture, leaving a perfectly white tube. In the clear-glass envelope, though, it's hardly visible.









Perhaps a few words about printing are in order. If you plan to submit photos to magazines or club bulletins, make them contrasty. The black areas should be jet-black, and the whites as white as the unexposed paper. This set of photos was printed on poly-contrast paper with no filter, corresponding to ordinary low-contrast paper (poly-contrast lets you change the paper rating by placing colored filters in the enlarger lamp). You can buy various contrast grades of paper, up to "ultra-hard" which I frequently use. This is "RC" or resin-coated paper which everyone uses nowadays. You can get gloss or matte finish, but try to use glossy for photos you send to magazines, as they are much easier for the offset printer to copy.

[The tubes illustrated are Moorhead Marconi/de Forest VT, De Forest DL-15, Sears WLS 2977, and Western Electric VT-2 with top of bulb marked in yellow.]

CASTING PLASTIC PARTS FROM AN EXISTING PART

V. E. Peterson

Vol. 16 No. 3, Dec. 1975

To replace hard-to-find knobs and other small parts, I have used the following method of making them, with acceptable results (see photo).

Parts are cast from polyester resin, colored to suit, and cast in a flexible silicone mold.

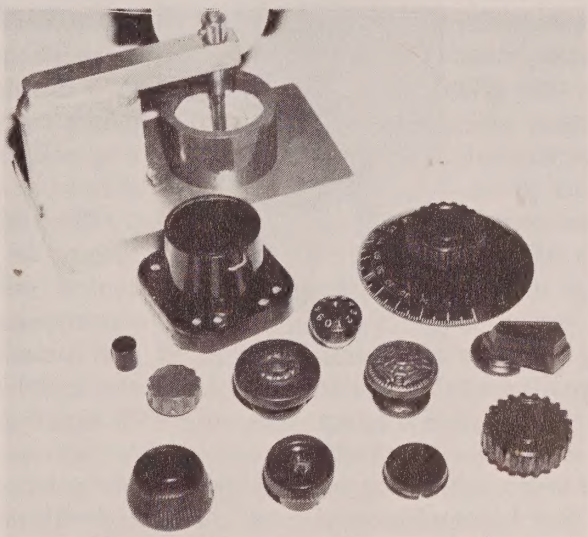
The knob that you wish to duplicate is positioned on a shaft in a fixture similar to the one shown in the sketch. The fixture may be made of wood or metal, as long as there is a container for the silicone and a method of positioning the knob.

Mix the silicone as per instructions and place it in a vacuum chamber to release trapped air. If a vacuum chamber is not available, let the mixture stand for about half an hour, then slowly pour into the fixture pot.

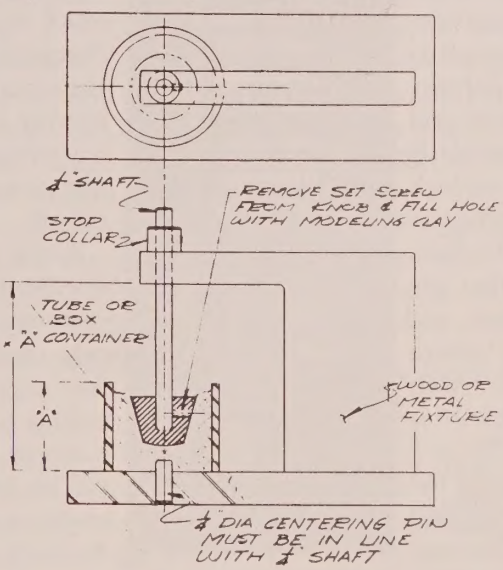
After the silicone has cured, a tapered knob may be removed easily. For knobs with larger heads (as in the sketch), the mold must be split with a blade partway down - then peel it free. You now have a mold in the outline of the knob you wish to duplicate.

To make the casting: mix a small amount of pigment with the resin. Small jars of red, green and black pigment will make almost any shade of brown or black casting. If additional strength is needed in the finished casting, a small amount of glass filler is added at this time.

Allow the mixture to stand for several minutes to release air bubbles before adding the catalyst. Position the mold on the fixture, coat the shaft with mold release, position the shaft in the mold cavity, and then slowly pour the mixture into the cavity. After the casting has cured, remove from the mold and sand or file excess material from the bottom of the part. In the case of a knob, drill a setscrew hole with a No. 28 drill and tap 8-32.



Parts made by the author with the mold fixture at upper left. Note the difficult Crosley "Pup" tuning knob (with numbers) in center.


¼" SHAFT
STOP COLLAR
REMOVE SET SCREW FROM KNOB & FILL HOLE WITH MODELING CLAY
TUBE OR BOX
2 x 'A' CONTAINER
'A'
WOOD OR METAL FIXTURE
¼ DIA CENTERING PIN MUST BE IN LINE WITH ¼ SHAFT

Forming mold with original part in fixture.

On parts which have lines or lettering, I use Lacquer Stik for fill. Many other parts lend themselves to duplicating in this manner. Other casting materials such as epoxy or steel-filled or aluminum-filled epoxy have been successfully used, as well as brass shaft bushings which may be molded in place.

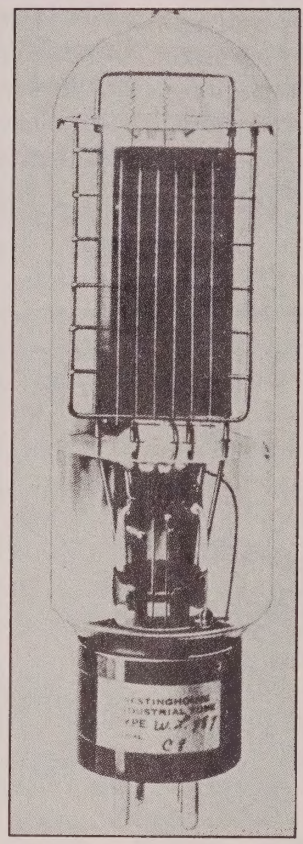
Possible sources for material are: Silicone molding compound, Dow Corning RTV-E or GE Type 700; casting resin (polyester), glass filler (Cab-O-Sil), and pigment, Plastic Sales Co., Kansas City, MO; white line filler (Lacquer Stik), 250 N. Washtenaw Ave., Chicago, IL 60602.

WESTINGHOUSE DEMONSTRATION TRIODE WL-787

(From a data sheet dated June 1936,
Special Products Sales Department, Westinghouse Lamp Company, Bloomfield, New Jersey)

Fact Sheet, Vol. 1, No. 3, August 1976

The featured tube in this Fact Sheet is an interesting tube manufactured by Westinghouse, Type WL-787. The tube was made in very limited quantities for use in classroom demonstrations. The Westinghouse Electronic Tube Division of Elmira, N. Y., has one of these tubes mounted with a power supply in a carrying case. Bruce Roloson brought this unit to an AWA Spring Meet here in Breesport a few years ago. [LAP]



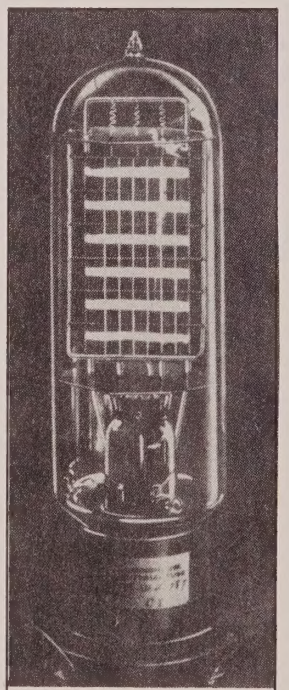
USES

The Westinghouse Demonstration Triode Tube WL-787 shows visually, in a manner impossible to accomplish in any other way, just what takes place when changes are made in the grid and plate voltages of a vacuum tube. In the lecture room it is now convenient to augment the theoretical discussion with a practical and visual demonstration of the operation of a triode.

By varying the grid voltage in steps over a Class A, B, or C excitation cycle, the effect of changing excitation on the electron flow from the filament to the plate and the corresponding correlation of this action with fluorescence on the anode can be readily shown. The description and theory concerning the operation of such a device may be supplemented by a demonstration of just what takes place in a three-electrode tube.

The distortion in an amplifier may be demonstrated by using a large excitation signal or a wide range of grid voltage values, by which it may be seen that the fluorescence line width will not vary to an extent proportional to the grid voltage changes. This is particularly true if the excitation is made so high that it causes the electrons and plate current to go beyond the cut-off values. In this case it will be seen that the fluorescence band width does not accurately follow the excitation voltage values, which corresponds with operation when distortion is experienced.

The amplification factor effect of the tube may be shown by noting the grid and plate voltages for a certain amount of fluorescence on the plate after which the grid bias voltage may be changed by a few volts, say 10, and it will be found that the plate voltage must be changed by a much greater amount to restore the original width to the bands of fluorescence. The ratio between the number of volts change in the plate circuit which compensated for the grid change, to the grid voltage change is a direct measure of, and is the actual amplification factor of the tube.

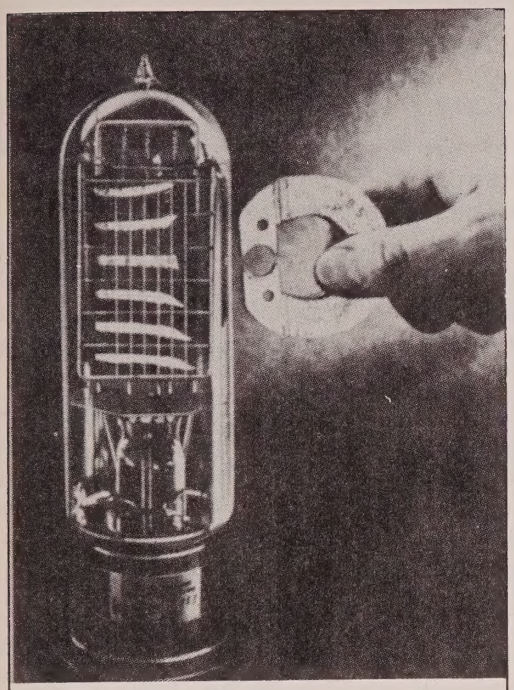


Typical pattern of fluorescence.

Another interesting demonstration can be made by holding a strong magnet near the side of the plate. In addition to showing the visual effect of the magnetic field on the electrons and their distribution, it is possible to obtain a representation of the lines of magnetic force under favorable conditions.

There will be a certain fluorescent pattern on the plate formed by the control effect of the grid on the electrons passing to the plate. As the grid is made more and more negative in voltage, the individual strips of fluorescence opposite each opening in the grid will become more and more narrow until finally they disappear altogether. The point at which the lines disappear will correspond with the grid bias value at which plate current cut-off occurs, and under which condition there will be no electrons reaching the plate. The grid may be made still more negative, in which case there will be no apparent change in the tube, which voltage value corresponds with the conditions existing in an actual triode when the net voltage on the grid is greater than that required to produce plate current cut-off.

As the grid voltage is made less negative from the point at which plate current cut-off is obtained, the fluorescence will reappear and the width of the strips will increase as the net voltage on the grid is decreased. As in a triode, the changes in fluorescence will be proportional to the number of electrons reaching the plate which is, naturally, a measure of the plate current. As the grid becomes positive with respect to the filament, the fluorescent



Magnetic effect on pattern of fluorescence.

lines become still wider until a positive grid voltage is obtained at which fluorescence covers the entire plate with a quite uniform intensity.

DESCRIPTION

The filament consists of several parallel oxide-coated wires, all of which are located in one plane so that the plate current will be uniformly distributed. The anode is the fundamental flat plate mounted parallel with the plane of the filament. The grid comprises a fairly open and conventional structure mounted between the filament and plate. The side of the anode next to the grid and filament is coated with willemite which shows a bright greenish fluorescence when bombarded with the electrons which form the plate current. A pronounced and clearly visible glow shows at all points where the electrons strike, resulting in a definite pattern of the grid on the plate.

The size and arrangements of all parts have been made so as to make the tube useful in illustrating the action of the grid in a three-electrode tube. All parts have been securely mounted and welded according to good current tube assembly practice. The plate size is such that the action will be visible to everyone in a lecture or class room of reasonable size. A slight amount of experimentation will show how the tube may be handled to demonstrate the desired effects. The tube is practically fool-proof in operation and will stand a wide variety of operating conditions. Either alternating current or direct current power may be used to heat the filament and to supply voltages for the grid and plate. A tube socket and the adjustable voltage sources are all that are needed to permit the operation of the tube, although some meters will be of convenience in making adjustments and readings.

DATA AND RATINGS

Filament Potential:	6 volts
Filament Current:	1.6 ampere
Filament Type:	Oxide Coated
Maximum Filament Potential:	6.3 volts
Maximum Plate Potential:	400 volts
Maximum Plate Current:	0.100 ampere
Maximum Grid Potential:	±200 volts
Maximum Grid Current:	0.050 ampere
Approx. Amplification Factor:	2
Plate Length (approx.):	3 inches
Plate Width (approx.):	1-½ inches
Maximum Overall Length:	10 inches
Maximum Diameter:	2-5/8 inches
Base Type:	4 pin Industrial
Socket:	S #793202

TIGHT SETSCREWS

Al Jochem

Vol. 19, No. 4, March 1979

Ever have a tight setscrew in a knob or dial? I have found the best way to loosen one is to use a soldering gun or iron with a very small tip - place the tip on the screw for several minutes and it will come free. Be very careful not to touch the side of the knob hole if it is plastic. Once the screw is removed, clean with a steel brush and oil it lightly.

REPLACING GLASS COVERS ON PHILMORE CRYSTAL SETS

Richard Cane

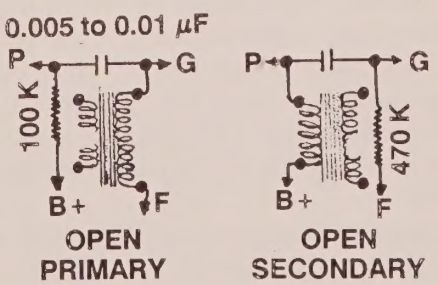
Vol. 15, No. 3, Dec. 1974

Occasionally Philmore crystal sets are found missing the glass cover for the detector. I have used the glass envelope of a loctal tube with great success: it is about the right size and fits well. I removed it from the base by scratching the glass carefully where it meets the base with a miniature file. Just keep rotating the tube as you file. When the scratch is deep enough and an even 360° around, hold the glass and gently tap. Try several positions until it breaks off. Be sure to rub some fine emery paper around the sharp edges.

OPEN AUDIO TRANSFORMERS

Vol. 6.No. 1, Spring 1965

In restoring an old set, one often finds the audio transformer open. With modern compact parts, you can bridge around, as shown, and hide the condenser and resistor inside the can out of sight.



THE PR-1-C (RCA UX-240)

Ken Gardner, W2BGN

Fact Sheet, Vol. 4, No. 1, Jan. 1979

Our feature article was supplied by AWA Vice-President Ken Gardner of New Hartford, N. Y. Ken was Director of Engineering at 50,000 watt radio station WHAM in Rochester, NY. His work included their FM and TV outlets. [LAP]

From Tyne's Saga, page 317: "In 1923 GE engineers started to develop a tube similar to the UV-201A but which had a much higher amplification factor, specifically designed for resistance-capacitance coupled amplification. It was submitted to RCA engineers the same year. It was adopted in the latter part of 1926, designated the UX-240, and announced in February 1927."

What happened to it in the years between 1923 and 1927? GE assigned the tube a number, PR-1-C, and used it for experimental work and at their station WGY. Perhaps it was also used in the GE carrier-current system for power companies.

My first contact with the PR-1-C came in December 1925 when the GE New York State Network was inaugurated, with WHAM in Rochester as the outlet there. The N. Y. S. Network was the first formal broadcast net in the country, established for the interchange of programs among WGY, WFBL, WHAM, and WMAK. Occasionally WJZ and WRC were connected to bring in important programs from New York or Washington. (NBC wasn't formed until November 1926.)

The network was connected by leased intercity Postal Telegraph lines. GE constructed reversible repeaters at GY, SY, HM and AK. When JZ was connected, a temporary repeater was manned at Poughkeepsie. Built into each repeater, a volume indicator showed the operator the program level fed to the line. These indicators were conventional vacuum-tube voltmeters using a PR-1-C and a DC galvanometer. Spare PR-1-Cs were furnished in plain cardboard boxes with handwritten labels. The tube, resembling a UX-201A in size, was tipless, inside-silvered, with UX base, and bore a paper sticker.

Just prior to the formation of the N. Y. S. Net, GE engineers constructed a condenser microphone for use at WGY. Mounted at the top of a heavy stand, the mic was connected by an eight-foot low-capacity cable one inch in diameter (we now call it coaxial cable!) to the preamp sitting on the floor. The center conductor was surrounded by cotton fibers, packed in and contained by a braided tinned-copper shield.

The preamp consisted of a PR-1-C tube, resistance-coupled to a UX-201A which was transformer-matched to a 200-ohm line to the main speech amplifier. Because of the low-level audio output of a condenser mic, tube microphonic noises in the preamp were a problem. This was solved by rubber suspension of the tube sockets, flexible wires, and a metal box around the amplifier, which in turn was acoustically insulated by inch-thick felt, with the whole thing floating within a heavy wooden box 8" X 8" at the base and approximately 14" tall. The power supply for two mics was a small 6-volt storage battery and 200 volts of B-battery. Can you imagine carrying all this around, plus main amplifier and power supply, on a remote pickup ("nemo job")?

Several of these mics were used at WGY and others loaned to N. Y. S.. Net stations. GE loaned four to WHAM in early 1926.

Tyne does not cover the RCA 841 or 842 in the Saga. These tubes were probably developed along with the 210 in 1922. The 841 was a high-μ and the 842 a low-μ version of the 210. They were first released in 1929 and discussed by Westman in the July 1929 *QST*, page 25. The low-μ tube was assigned a number PR-11. It had no markings but looked like a 210 except for the coarse grid structure. It was used in the GE reversible N. Y. S. Net repeaters. There were four PR-11s in a repeater, wired for two push-pull outputs, a convenience in switching. The first-stage amplifier was a 210. A storage battery fed the filaments and a GE type 101 RAC power supply fed 425 volts to the plates. Bias by batteries.

One wonders how many other early tubes were assigned PR-numbers and if any are in existence today. *[See OTB 31-1-33 for a table. Ed.]*

RCA Radiotron UX-240

(High-Mu)
Detector Amplifier

Radiotron UX-240 is designed for use in resistance or impedance-coupled amplifier circuits as either detector or amplifier.

Having an Amplification Factor (Mu) of 30, Radiotron UX-240 will be welcomed, particularly by set builders who prefer resistance-coupled amplification. Where tubes of the general purpose type have heretofore been used in resistance-coupled circuits, improved amplification may now be obtained by the use of one or two Radiotrons UX-240.

The UX-240 may be used in the popular types of resistance-coupled amplifier circuits without change in plate coupling resistances, but with superior results. The best performance is obtained, however, when resistance values recommended in the instruction sheet are employed.

Radiotron UX-240 consumes less than one tenth the plate current of the average general purpose tube. The filament is identical to that of Radiotron UX-201-A.

Radiotron UX-240.....$2.00

THE SPLIT-ANODE MAGNETRON

Bruce Roloson

Fact Sheet, Vol. 5, No. 3, August 1980

The magnetron is a vacuum device controlled by a magnetic field. It is one of the more unique electron devices in its operation and application.

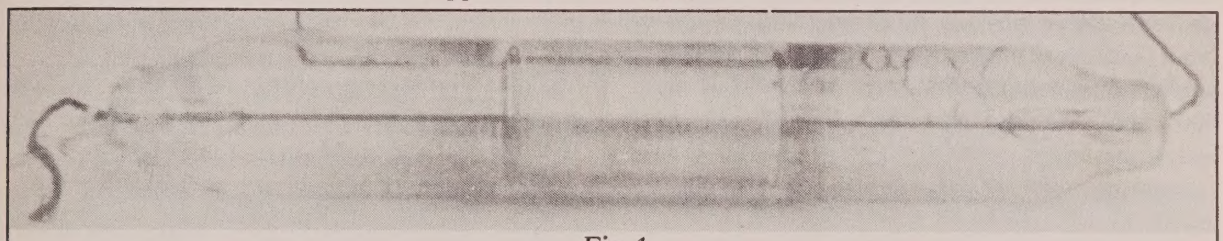


Fig. 1

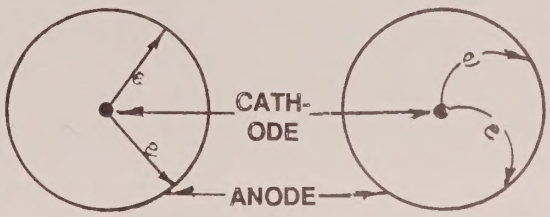
Most of the early work on magnetrons was done by Albert W. Hull, a GE engineer, from about 1918 to the late 1920s. Hull's earliest work was on the dynatron (Tyne, G. F. J., Saga of the Vacuum Tube, p. 146) and pliodynatron, whose "Graeco-Schenectady" names imply power generator and grid-controlled power generator respectively.

The dynatron devices were designed to operate as high-frequency generators using a negative-conduction theory. A refinement of the dynatron was accomplished by placing a coil around the device so that a magnetic field was set up parallel to the axis of the device. The dynatron is a rather complicated device to understand as well as to operate.

Hull narrowed his experiment of magnetic control to a simpler device than the dynatron, as shown in Fig. 1, which is a simple magnetron. The operation of this device can be explained readily. First consider the operation of a rectifier using a cathode surrounded by a cylindrical plate (Fig. 2A). The electrons emitted from the cathode will flow in a straight line to the anode. While the basic structure in a magnetron is the same, a magnetic field is added parallel to the axis of the device. This will cause the electrons to move in concentric circles (Fig. 2B) which become tighter as the magnetic field is increased. A diagram of how this device would be set up can be seen in Fig. 3.

There had been many devices before the Hull experiments that used a coil of wire or plate on the outside to limit current flow inside the device by means of an electrostatic field. These devices should not be mistaken for magnetrons.

In 1921 a magnetically controlled device operating differently was being worked on by V. Bush and C. G. Smith of the AMRAD Company. These two men were the developers of the AMRAD "S" tube, which uses a cold-cathode mean-free-path theory of rectification. They carried the "S" tube one step beyond by controlling conduction with a magnetic field (Fig. 4). This magnetically controlled tube was known as the "H" tube.



Figs. 2A and 2B

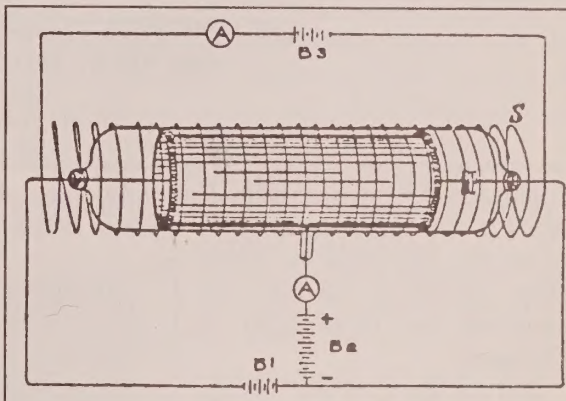


Fig. 3

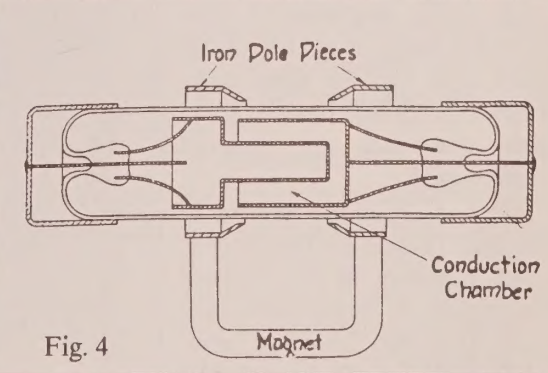


Fig. 4

Hull's early cylindrical-plate magnetrons were used as amplifiers and oscillators by other inventors of that period, such as E. F. W. Alexanderson, as seen in Fig. 5, which is from a patent of September 28, 1920.

In the late 1920s the General Electric Co. intro-

duced one of the first magnetrons that had passed from the experimental stage. It was designated FH-11. A sample from the Peckham collection is pictured. It can be seen that there are two anodes, semi-cylindrical in shape and separated by two equal, longitudinal slits. These anodes are supported by two leads which run out at the top of the tube and serve as external connections. Fins on each anode provide additional dissipation of heat. Technical information: filament 5 volts at 5 amps, anode voltage 1500 at 50 mA, field strength 700 gauss. Output was approximately 15 watts with a minimum operable wavelength of 0.75 meters. At 50 meters an output of 50 watts could be obtained. A General Electric catalog dated May 1930 gives additional data on the FH-11.

NUMBER 1,535,082 - Electron Discharge Device

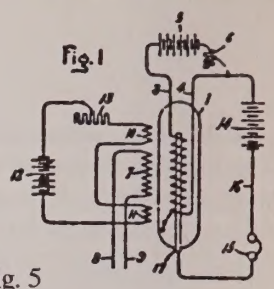
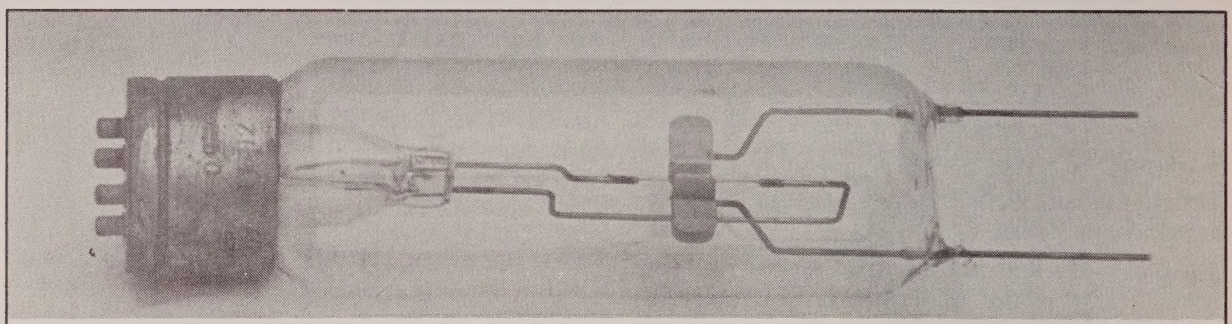


Fig. 5



GE FH-11 magnetron. (Photo by Kent Peckham)

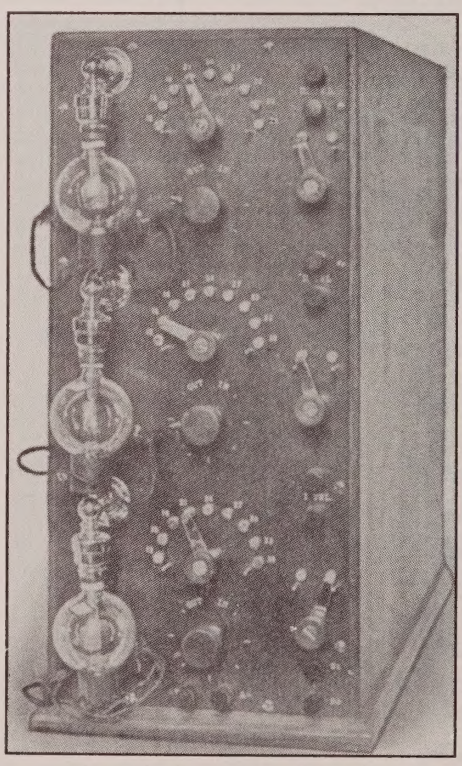
DE FOREST THREE-STAGE AMPLIFIER - THE FIRST NEUTRALIZED CIRCUIT?

Charles Henry

Vol. 5, No. 4, Winter 1964

The antique three-stage de Forest amplifier pictured in the winter issue of the Bulletin brings to mind the instability in three-stage amplifier circuits not equipped for suppression of feedback.

Did not the U. S. Navy in the 1913-15 era give de Forest a contract for a quantity of three-stage audio amplifiers? And were not many, if not all, of the Navy and civilian three-stage amplifiers equipped with capacitive feed-back to prevent "squealing"?



Mr. L. C. F. Horle told me in the mid-Twenties, when he was chief engineer of the Federal Telephone & Telegraph Company, that Mr. Logwood, erstwhile with Dr. de Forest, had said that since many of the Navy amplifiers "squealed," when they did he soldered a piece of insulated magnet wire to the grid connection of the first stage and a similar piece of wire to the grid circuit of the third stage. By twisting the (insulated) wires together, enough inter-circuit capacity was obtained to stop squealing. If this was overdone and the amplifier was not sufficiently lively, the feed-back capacity could be reduced by clipping the ends of the twisted wires, thereby reducing capacity, whereupon the amplifier became lively but stable.

Mr. Horle earnestly desired, but never did procure, a de Forest three-stage amplifier incorporating this neutralizing device. He believed that by showing such prior commercial use and sale, the salient claims of the "neutrodyne" patent would be nullified. There is no record that de Forest attempted to patent Logwood's discovery.

Does anyone own a de Forest three-stage amplifier and does it have Logwood's "anti-squeal" modification? I would like to hear from our readers on this subject.

ORIGINS OF THE AWA MUSEUM

AN IMPORTANT MESSAGE TO ALL MEMBERS

Vol. 5 No. 1, Spring 1964

AWA members have been concerned for some time over the housing of the members' equipment. A solution may be in sight.

As most of you know, our secretary, W2ICE, has graciously donated the use of his two-story carriage barn for this purpose for several years. This followed since he had the facilities and was the principal owner of equipment; however, he and the rest of us find there is now a need to find bigger and better quarters.

The local Chamber of Commerce, as well as the County Historian, are deeply interested in our venture. At a recent meeting of the Chamber, it was unanimously agreed to obtain a building to house the town library and the club's museum.

Officers and several board members have viewed a building which is under consideration. It is the former village school and Town Hall and now the Grange Building. It is a well built brick structure and outwardly has all the appearances of a historical building in a pleasant setting of trees and lawns.

If the program materializes, the AWA will have the large exhibit hall on the second floor. As an organization, we will have full responsibility of all equipment, exhibits, etc. I feel it is a step in the right direction.

73, George Batterson, W2GB, President

MUSEUM OUTLOOK

Vol. 12 No. 2, Sept. 1971

At a recent meeting of the Town of East Bloomfield Historical Society, facilities were offered AWA to house their historical collection in the Town's Public Museum. The offer was left open pending the AWA board's decision. I propose to set up a fact-finding committee in the near future to look into this matter.

Many are familiar with the Town's museum - a historical building located on the village green, and one-time Academy. The Society is currently restoring the three-story brick building with money from a local fund drive.

AWA officers, as well as some members, have been concerned over the Association's collection. They are realistic enough to know it cannot be housed forever in Kelley's rebuilt carriage barn. Our by-laws protect the equipment, with many items assigned to national museums in event of dissolution.

The latter, however, is negative thinking, since most agree the entire collection should remain intact and directly or indirectly under AWA supervision or a responsible group of radio historians and engineers. . .

73, George Batterson

AWA HISTORICAL MUSEUM FUND

Vol. 12 No. 2, Sept. 1973

At last! The Association is on the final road to having a public museum. It will be the only museum of its kind in the country - a public museum devoted entirely to radio and electronic equipment, operated by a non-profit group of amateurs.

There is much to be done. The building is in the process of being restored by the Town Historical Society. AWA will share a section of the second and third floors, with the option of erecting a separate building if sufficient funds are available at a future date. There will be a need to build interior walls, display areas and install all-new electrical wiring. This is a challenge to the finance committee with present-day building costs.

It has been decided not to have a hard-driving fundraising campaign. Members who have the spirit and desire to preserve and display historical equipment may donate to the fund, which had a rousing start from pioneer radio astronomer Grote Reber. Recognition will be given to contributions of $50 or more by an engraved plaque with the donor's name permanently mounted on a show case or display area. All contributions of any amount are tax-deductible for IRS purposes.

HOORAY! WE'VE DONE IT! AWA NOW PART OF PUBLIC MUSEUM

Vol.14 No. 4, March 1974

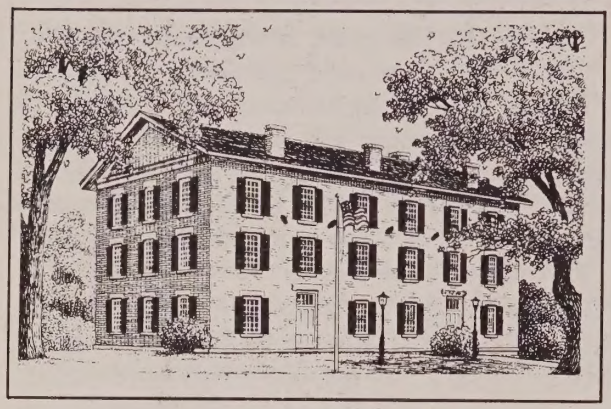
Your organization has signed a long-term lease with the Town of Bloomfield Historical Society for exhibit area in their Academy Museum. Much thought and effort has gone into this move by your officers and attorney.

It has always been felt AWA could better serve its objective in exhibiting and preserving electronic equipment by having a display in an existing public museum instead of trying to maintain one of their own. The latter possibility has not been completely ruled out, however.

The Town of East Bloomfield Historical Society is a group of citizens living in several small villages, with Holcomb and East Bloomfield in the center. It was chartered by the New York State Board of Regents several years ago as an educational organization. In addition to the usual historical activities, they have also undertaken the task of restoring a local landmark - the Bloomfield Academy, a three-story brick building adjacent to the village green. Part of the building will be our museum. Several AWA members are also members of the Bloomfield Historical group.

AWA Museum will be a separate area in the Bloomfield Museum. We will have approximately

THE MUSEUM



AWA ELECTRONIC COMMUNICATION MUSEUM

Location: Village Green, Rtes. 5 & 20, East Bloomfield, New York
Hours: May 1 through October 31: Sunday, 2-5 PM; June 1 - August 31: Saturday, 2-4 PM; Wednesday, 7-9 PM. (Closed Holidays)
Group tours by appointment: 716-657-7489
Museum telephone: 716-657-6260
Amateur Station: W2AN
FREE ADMISSION

one-half of the second floor and part of the third. AWA will maintain its own area, which includes separate staircase and locked doors. Our main exhibit space will be a large vaulted room the full width of the building. This room will be lined with glass showcases and will be accessible to the Historical Society's Museum. The area will be open and operate in conjunction with the Society's Museum. The remaining sections will house specialized equipment, not generally open to the public. Exhibits will be selective, meaning some material will not be moved from the present site.

Other information: Our operation will be fully covered with adequate fire and liability insurance to comply with state law relative to public buildings. It is estimated it will cost the Association approximately $1000 a year to maintain the museum. This includes rent, insurance, electricity and maintenance. In addition to a $5000 material/labor cost for renovation, there will be need for much volunteer work from local members. Saws, hammers and paint brushes are being readied and Cundall and others are cleaning and restoring equipment for the big move. It is doubtful it will be ready for the Conference since there is much construction work to be done by both the Historical Society and AWA. Future Bulletins will keep members posted on progress.

The "1925 store" re-creation in the Museum. (Vol. 16, No. 2, Sept. 1975)